Arctic Search and Rescue Training Exercise 2015 Yellowknife – Inuvik

The purpose of this year's MJX is to test the capabilities of the Arctic District units and their ability to work with other agencies when tasked on a Multi-Jurisdictional event north of 60. Currently we have nine operational CCGA units north of 60 and in various communities from the east coast of Baffin Island to Beaufort Sea, this years planned event will bring seven of the nine units to two separate location to take part in this exercise. Given the distances in the north getting CCGA members from seven units to the locations of the exercises is unprecedented.

The current plan is to have the seven unit take part in two separate events in two locations, the first exercise will take place on Saturday July 25th on Great Slave Lake with CCGA, RCMP, CF, DFO and CASARA taking part in a simulated search for a vessel in transit from Yellowknife to Hay River NWT. The search effort will be focused on the Devils Channel area and proceed to the South West during the exercise. The second event will take place on July 26th on the Mac Kenzie Delta north of Inuvik to the Beaufort Sea the search will be comprised of CCGA units from Inuvik and Tuktoyaktuk along with OGD's including the RCMP, CCG (TBD) CF, CBSA and CASARA. This search will focus on a disabled vessel on the Delta with a Medical Emergency onboard.

Objectives

1. Plan and execute a Multi – Jurisdictional exercise north of 60 with the CCGA, RCMP and OGD.
2. Test the response capabilities of the CCGA units in the north when tasked by the JRCC/RCMP
3. Provide a training event for the majority of the Arctic District Units and evaluate the units against the new training standard (Phase Training) this will include SAREX check rides>
4. Collect and provide objective data on the response and support functions for the exercise to each participating organization. The information will be used to improve the contingency response plans of agencies that take part in the exercise.
5. Provide and objective report on communications during the exercise, this includes situational reports from the units during exercise and dissemination of the information by tasking party.
6. Provide a training direction on the southern exercise (Yellowknife) to the local tasking authority.

RAMSARD

SAR Capability Rating of Marine Resources

Table of Contents

SAR CAPABILITY RATING CRITERIA

SAR capability is described as the ability of resources to provide response to SAR incidents.

*MARINE RESOURCES SAR CAPABILITY RATINGS - SAMPLE**

Resource	Marine Resources SAR Capability Ratings*											
	A Speed	B End	C SK	D S	E Rec	F FA	G OSC	H Tow	I FPE	J DeW	K R/R	L S/S	Total Ratings*
CCG ZH 753 Fast Rescue Craft (includes Inshore Rescue Boat)	7	2	5	2	1	3	2	2	1	2	2		**29**
CCG 47' Motor Lifeboat	4	4	5	4	4	4	4	4	4	2	4		**43**
CCG Mid-shore Patrol	2	7	6	5	6	4	5	5	4	2	6		**52**
CCGA Offshore Fishing Vessel	2	7	4	1	5	2	3	3	1	1	1		**30**
DND Maritime Coastal Defence Vessel	2	7	4	4	5	4	6	4	3	1	4		**44**

**Ratings are to be applied to each resource available in the Area under review.*

*** The rating number is only used for rough comparative purposes. The criteria themselves have not been prioritized against each other - they are all considered equally important.*

- Where possible, the SAR Capability Rating is linked to a standard (e.g. SAR Service Standard, CCG Statements of Operational Requirements, CGFO 207 SAR Equipment, and IAMSAR Volume III - Mobile Facilities).
- Where such a standard does not exist, the criteria have been established by SAR experts and will be validated on an ongoing basis.

The following eleven SAR capabilities and their associated rating criteria are to be used as a reference for rating of Marine Resources:

A. Speed
B. Endurance / Range
C. Sea keeping
D. Search
E. Survivor Recovery/Care/Transportation
F. First Aid / Medical
G. On Scene Coordination
H. Towing
I. Fire Protective Equipment
J. Dewatering
K. Redundancy

SAR Capability A – Speed (Sp)

Rating	Criteria
7	Vessel able to make 40 knots or greater.
6	Vessel able to make 35 knots or greater.
5	Vessel able to make 30 knots or greater.
4	Vessel able to make 25 knots in fair conditions, or major vessel able to launch independent Fast Rescue Craft (FRC) that can make 25 knots.
3	Vessel able to make 20 knots.
2	Vessel able to make 15 knots.
1	Vessel able to make 10 knots or less.
Standards / application of criteria	There is no defined speed requirement standard, but speed is rated as it affects time to reach an incident and how quickly a resource can be dispatched to return the SAR unit for readiness posture.

SAR CAPABILITY B – ENDURANCE / RANGE (END)

Rating	Criteria
7	Vessel range of at least 800 NM and greater than 40 hours of continuous operation.
6	Vessel range of at least 600 NM and 30 hours of continuous operation.
5	Vessel range of at least 400 NM and 20 hours of continuous operation.
4	Vessel range of at least 200 NM and 10 hours of continuous operation.
3	Vessel range of less than 200 NM and 10 hours of continuous operation.
2	Vessel range of less than 100 NM and 5 hours of continuous operation.
1	Vessel range of less than 50 NM and 3 hours of continuous operation.
Standards / application of criteria	Although these criteria are more useful for offshore Areas and extended incidents, all assets will be rated.

SAR CAPABILITY C – SEA KEEPING (SK)

Rating	Criteria
7	Vessel able to operate effectively in storm conditions (winds of 50-55 knots) and sea state 10 (9-12.5 metres in open sea).
6	Vessel able to operate effectively in a strong gale (winds of 45 knots) and sea state 9 (7-10 metres in open sea).
5	Vessel able to operate effectively in a gale (winds of 35-40 knots) and sea state 8 (5.5-7.5 metres in open sea)
4	Vessel able to operate effectively in a near gale (winds of 30 knots) and sea state 7 (4-5.5 metres in open sea).
3	Vessel able to operate effectively in a strong breeze (winds of 25 knots) and sea state 6 (3-4 metres in open sea).
2	Vessel able to operate effectively in a fresh breeze (winds of 20 knots) and sea state 5 (2-2.5 metres in open sea).
1	Vessel able to operate effectively in a moderate breeze (winds of 15 knots) and sea state 4 (1-1.5 metres in open sea).
Standards / application of criteria	Existing requirement to operate in the prevailing environmental conditions: Beaufort Scale (http://www.tc.gc.ca/eng/marinesafety/tp-tp10038-80-wi-beaufort-scale-324.htm).

SAR CAPABILITY D – SEARCH (S)

Rating	Criteria
7	Vessel has all equipment noted below; at least 20 feet height of eye; and sufficient crew to conduct visual and electronic searches simultaneously.
6	Vessel has all equipment noted below and Forward Looking Infrared (FLIR).
5	Vessel has baseline equipment plus Self Locating DMB (SLDMB).
4	Vessel has the following equipment and attributes: • electronic navigation equipment sufficient to conduct extended search in restricted visibility; • enclosed bridge with at least 8 feet height of eye; • Data Marker Buoy (DMB); • Direction Finder (DF); • binoculars; • search light with minimum candle power; and • night vision equipment.
3	Vessel has electronic navigation equipment, but does not carry one of the following: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; or • night vision equipment.
2	Vessel has electronic navigation equipment, but does not carry two of the following: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; or • night vision equipment.
1	Vessel does not have electronic navigation equipment or does not carry: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; nor • night vision equipment.
Standards / application of criteria	SAR

SAR CAPABILITY E - SURVIVOR RECOVERY, CARE AND TRANSPORTATION (REC)

Rating	Criteria
7	Vessel can carry more than 50 survivors in a sheltered location.
6	Vessel can carry more than 25 survivors in a sheltered location.
5	Vessel can carry more than 12 survivors in a sheltered location.
4	Vessel can carry less than 12 survivors in a sheltered location.
3	Vessel can carry less than 12 survivors in an exposed location.
2	Vessel can carry less than five survivors in a sheltered location.
1	Vessel can carry less than five survivors in exposed location.
Standards / application of criteria	Safety of Life at Sea SAR Convention - retrieve persons in distress, provide for their medical or other needs and deliver them to a place of safety.

SAR CAPABILITY F - FIRST AID / MEDICAL TRAINING, SPACE AND EQUIPMENT (FA)

Rating	Criteria
7	Doctor of Emergency Medicine or equivalent.
6	Advanced Care Paramedic (ACP) or equivalent (e.g. Physician's Assistant).
5	Primary Care Paramedic (PCP) or equivalent (e.g. DND SAR Technician).
4	CCG Rescue Specialist or equivalent (e.g. Emergency Medical Responder [3-week training course]) with SAR first aid equipment as per CGFO 207 or equivalent, and sheltered space for at least one stretcher patient.
3	Advanced first aid training (e.g. Marine Advanced First Aid, Medical First Responder, Advanced Wilderness First Aid, OFA 3 [1- or 2-week course]) or no shelter for at least one stretcher patient.
2	Standard first aid training (e.g. Marine Basic First Aid, Standard First Aid [2-day course]).
1	No first aid training (vessel may have First Aid trained person on board, but there is no requirement that this be carried).
Standards / application of criteria	CCG's SAR Levels of Service / Service Standards require that "all SAR units carry a trained Rescue Specialist capable of providing pre-hospital medical care".

SAR CAPABILITY G - ON-SCENE COORDINATION (OSC)

Rating	Criteria
7	Vessel has capability to co-ordinate air search in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
6	In addition to the attributes below Vessel has sufficient crew to conduct simultaneous visual and electronic searches in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
5	Vessel has sufficient crew to have a full navigational watch and an On-Scene Coordinator in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
4	Vessel has the following attributes: • sufficient communications equipment (minimum 2 VHF radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
3	Vessel is missing one of the attributes of the rating 4 criteria
2	Vessel is missing two of the attributes of the rating 4 criteria
1	Vessel is missing three of the attributes of the rating 4 criteria
Standards / application of criteria	For longer and more complex cases, the On-Scene Coordination attribute is a fundamental resource provided by CCG.

SAR CAPABILITY H - TOWING (TOW.)

Rating	Criteria
7	Vessel is fitted for towing large displacement hull vessels and has a bollard pull of greater than 50 tonnes
6	Vessel is fitted for towing large displacement hull vessels and has a bollard pull of 20 to 50 tonnes
5	Vessel is fitted for towing displacement hull vessels greater than 36 feet and has a bollard pull of less than 20 tonnes
4	Vessel is fitted for towing a displacement hull vessel of at least 36 feet in 30 knot winds
3	Vessel is fitted for towing a displacement hull vessel of at least 30 feet in 20 knot winds
2	Vessel is fitted for towing a planning hull vessel of at least 24 feet in 20 knot winds
1	Vessel is not fitted for towing (no tow post or tow line)
Standards / application of criteria	Although towing may be a service of last resort, it can be a useful and practical SAR response strategy.

SAR Capability I - Fire Protective Equipment (FPE)

Rating	Criteria
6	Vessel has: • capability to refill self-contained breathing apparatus (SCBA) bottles on board; • spare SCBAs and bottles that can be transferred to casualty; • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
5	Vessel has: • spare SCBAs and bottles that can be transferred to casualty; • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
4	Vessel has: • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
3	Vessel has: • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
2	Vessel has additional extinguisher(s) that can be transferred to casualty
1	Vessel carries no additional fire protective equipment
Standards / application of criteria	In line with Fleet Safety Manual 7.D.1 Search and Rescue Operations.

SAR Capability J - Dewatering (DeW)

Rating	Criteria
4	Vessel has a high-capacity submersible pump that can be deployed to another vessel
3	Vessel has two dewatering pumps, including one that can be deployed to another vessel
2	Vessel has a dewatering pump (minimum 3.5 hp) that can be deployed to another vessel
1	Vessel has no portable dewatering capability
Standards / application of criteria	In line with CGFO 207 - SAR Equipment

SAR Capability K - Redundancy/Robustness (R/R)

Rating	Criteria
7	Vessel: • Has double hull; • stability condition for deck icing; • has three independent means of position fixing; or two compasses or VHF DF; and • Is twin screw and has backup steering system
6	Vessel: • stability condition for deck icing; • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
5	Vessel: • has double hull; • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
4	Vessel: • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
3	Vessel is twin screw and has backup steering system.
2	Vessel is twin screw.
1	Vessel has no redundancy of systems.
Standards / application of criteria	Statement of Operational Requirements for Offshore SAR ships, Motor Lifeboats, and Inshore Rescue Boats.

MARINE RESOURCE DESCRIPTION

CANADIAN COAST GUARD ZH 753 FAST RESCUE CRAFT (INCLUDES INSHORE RESCUE BOAT)

7.53 metre rigid hull inflatable, typical crew of 3, twin outboard engines or inboard diesel engine, high speed (40 knots+), electronic navigation suite, capsize reversal system, SAR equipped.

		SAR Capability	Rating
A	Speed	40 knots +	
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD 47' MOTOR LIFEBOAT

Crew of 4, self-righting, 25 knots.

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD 57' MOTOR LIFEBOAT

Crew of 4, self-righting, 25 knots.

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD AIR CUSHION VEHICLE

Crew of 4-8, self-righting, 50 knots+

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

Crew of 6-16

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

Crew of 19-29

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD OFFSHORE OCEANOGRAPHIC

Crew of 20-37

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD OFFSHORE PATROL

Crew of 17-20

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD MEDIUM ENDURANCE MULTI-TASKED

Crew of 20-24

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD MEDIUM OR HEAVY ICEBREAKER

Crew of 24-46

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CCG Auxiliary ZH Fast Rescue Craft

7.53 metre rigid hull inflatable, typical crew of 3, twin outboard engines or inboard diesel engine, high speed (40 knots+), electronic navigation suite, capsize reversal system, equipment and training varies by region and unit.

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CCG Auxillary Dedicated Response Vessel

Vessel capabilities, equipment and training varies by region and unit

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

CANADIAN COAST GUARD AUXILIARY OWNER OPERATOR

Vessel capabilities, equipment, and training varies by region and unit

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

RCMP PATROL CATAMARAN

18-20 metre aluminum catamaran, high speed (25 knots+) patrol vessel, crew of 4

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

DND MARITIME COASTAL DEFENCE VESSEL

55 metre patrol vessel, crew of 30 naval reserve, max speed 15 kts, range 500nm at 9 knots

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

DND Patrol Frigate

134 metre patrol vessel, crew of 225 max speed 30 knots +, may carry helicopter

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

VESSEL OF OPPORTUNITY

		SAR Capability	Rating
A	Speed		
B	Endurance /Range		
C	Seakeeping		
D	Search		
E	Survivor Recovery, Care, Transportation		
F	First Aid Training, Space, Equipment		
G	On-Scene Coordination		
H	Towing		
I	Fire Protective Equipment		
J	Dewatering		
K	Redundancy/ Robustness		
	Total		

MARINE RESOURCES SAR CAPABILITY RATINGS MATRIX

Resource	Marine Resources SAR Capability Ratings*												
	A Speed	B End	C SK	D S	E Rec	F FA	G OSC	H Tow	I FPE	J DeW	K R/R	L S/S	Total Ratings*

**Ratings are to be applied to each resource available in the Area under review.*

*** The rating number is only used for rough comparative purposes. The criteria themselves have not been prioritized against each other - they are all considered equally important.*

Factors Evaluated in Each Community:

During the RAMSARD process, the project team evaluated a number of factors in each community. The results are summarized here, with full results contained in Annex X.

1. Community Characteristics

Various community characteristics were evaluated, including population, industrial development, infrastructure, transportation access, and local services. These were examined to ensure that a holistic regional picture was made available, and all relevant characteristics were examined.

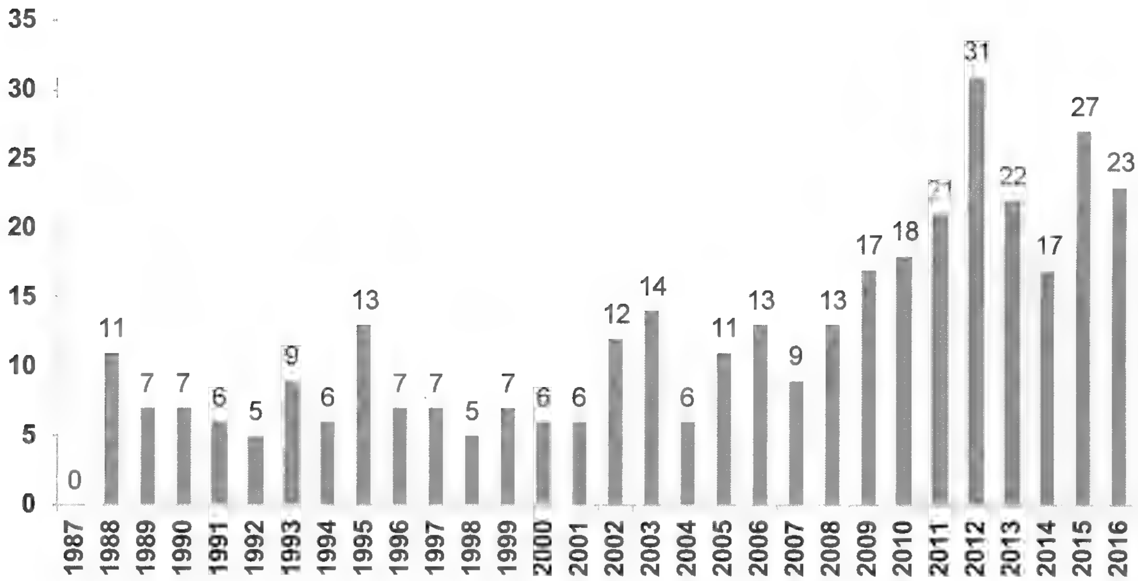
1.1 **Population of Community:** The populations of the communities examined during the Arctic SAR study varied greatly. Iqaluit, NU was the largest community visited with a population of 7,740, while many smaller communities were also surveyed, including Grise Fjord, NU (129), Resolute, NU (198), Kimmirut, NU (389), Aupaluk, QC (209), and Sachs Harbour, NT (103).

1.2 **Industrial development (including tourism, commercial fisheries, and mining):** Generally speaking, activity in the Arctic is on the rise. This activity includes an increase in resource development on-shore, coupled with an increase in marine activity via cruise ships, ecotourism and adventure operators. The following charts depict the number of full and partial transits of the Northwest Passage, as collected by NORDREG.[1]

[1] The following vessels are prescribed as classes of vessels for the purposes of subsections 126(1) and (3) of the Canada Shipping Act in respect of the NORDREG Zone:

- **(a)** vessels of 300 gross tonnage or more;
- **(b)** vessels that are engaged in towing or pushing another vessel, if the combined gross tonnage of the vessel and the vessel being towed or pushed is 500 gross tonnage or more; and
- **(c)** vessels that are carrying as cargo a pollutant or dangerous goods, or that are engaged in towing or pushing a vessel that is carrying as cargo a pollutant or dangerous goods.

Full Transits of the Northwest Passage:

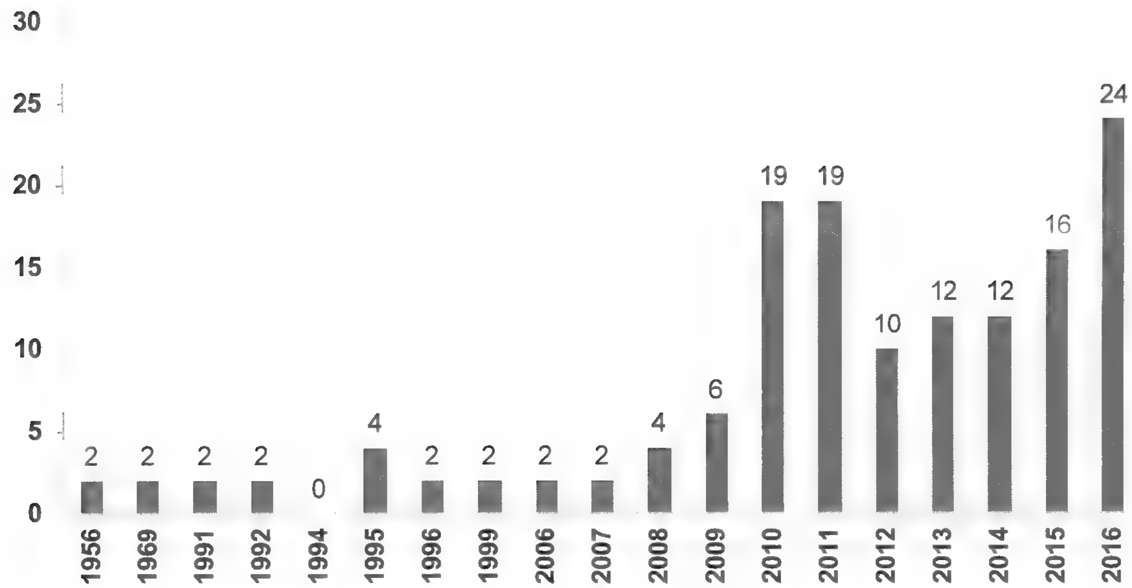


The following chart and table depict the number of partial transits of the Northwest Passage, as collected by NORDREG.[2] A partial transit westwards is considered as far west as Cambridge Bay and a partial transit eastwards is considered as far east as Resolute Bay.

[2] The following vessels are prescribed as classes of vessels for the purposes of subsections 126(1) and (3) of the Canada Shipping Act in respect of the NORDREG Zone:

- **(a)** vessels of 300 gross tonnage or more;
- **(b)** vessels that are engaged in towing or pushing another vessel, if the combined gross tonnage of the vessel and the vessel being towed or pushed is 500 gross tonnage or more; and
- **(c)** vessels that are carrying as cargo a pollutant or dangerous goods, or that are engaged in towing or pushing a vessel that is carrying as cargo a pollutant or dangerous goods.

Partial Transits of the Northwest Passage:



In addition to statistics on commercial vessel transits, the examination of commercial development in each community allowed the project team to provide forecast expected commercial maritime activities associated with the development.

For example, a $1.2B (USD) expansion of mining activities by Agnico Eagle in Rankin Inlet, NU would increase dedicated commercial shipments by 11 vessels in 2017 and contain upwards of 4,500 containers.[3]

Similar expansion plans have been proposed by Baffinland in Pond Inlet, where an application has been submitted to increase its shipping allowance from 4,200,000 tonnes (corresponding to 147 vessel loads[4]) to 12,000,000 tonnes of ore by 2018, which would potentially increase both the size and number of ships passing through Milne Inlet and Eclipse Sound.

In addition, Baffinland had requested an extension in their operating season from July 1 to December 31 annually, and the ability to bring in sealift vessels

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[3] Retrieved 06 November 2017 from: http://www.qsl.com/imports/medias/fichier-medias/tpq-interview-arctic-business-march-2017.pdf
[4] Retrieved 06 November 2017 from: http://qia.ca/summer-shipping-schedules-for-baffinlands-mary-river-project/

for resupply during the winter months.[5] As of 2017, Baffinland deployed 56 vessels (each carrying an average of 72,600 tonnes of iron ore) from August to October to ship the high-grade ore from its Milne Inlet Port near Pond Inlet, to markets in Germany, the United Kingdom and Japan.[6]

In addition to these commercial activities, there is also an increase in the level of commercial tourism being conducted in a number of communities along the Northwest Passage routes. The following map displays the navigable routes through the Northwest Passage.

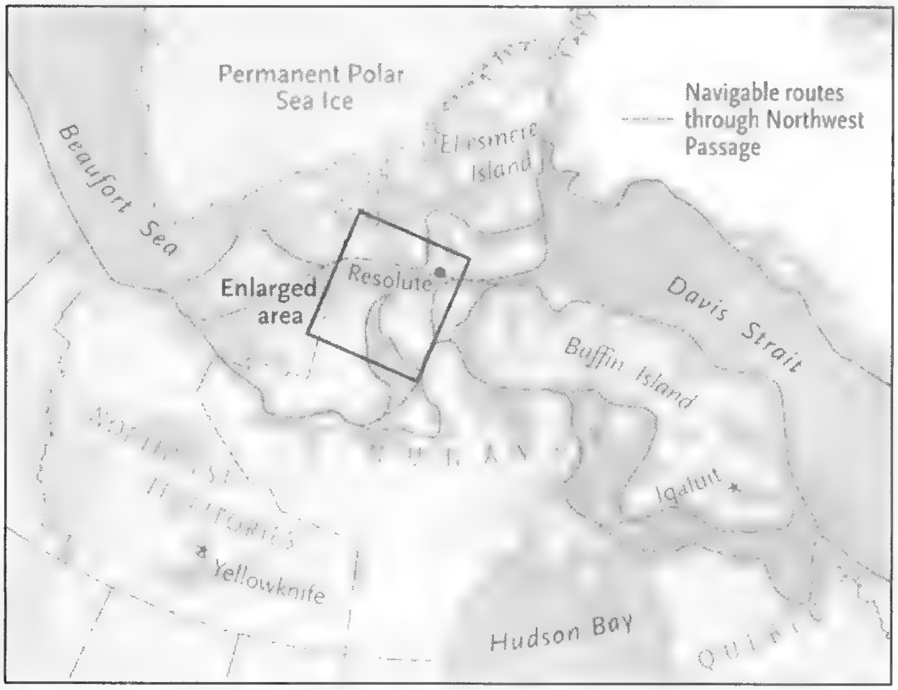

Figure 1. Navigable Routes through the Northwest Passage
(Map: Chris Brackley/Canadian Geographic)

There are a number of sea routes which connect the Pacific and Atlantic Oceans, via the Arctic. These include the Northwest Passage and Northeast Passage / Northern Sea Route. With the changing weather conditions in the region, these routes may become more commercially viable in the coming years.

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[5] This proposal appears to have been scrapped, as per a Nunatsiaq News Article, from November 6, 2017: http://www.nunatsiaqonline.ca/stories/article/65674nunavut_mining_company_takes_ice_breaking_off_the_table/

[6] Retrieved 06 November 2017 from: http://www.rcinet.ca/eye-on-the-arctic/2017/10/20/baffinland-mine-ships-record-amount-of-iron-ore-in-2017/

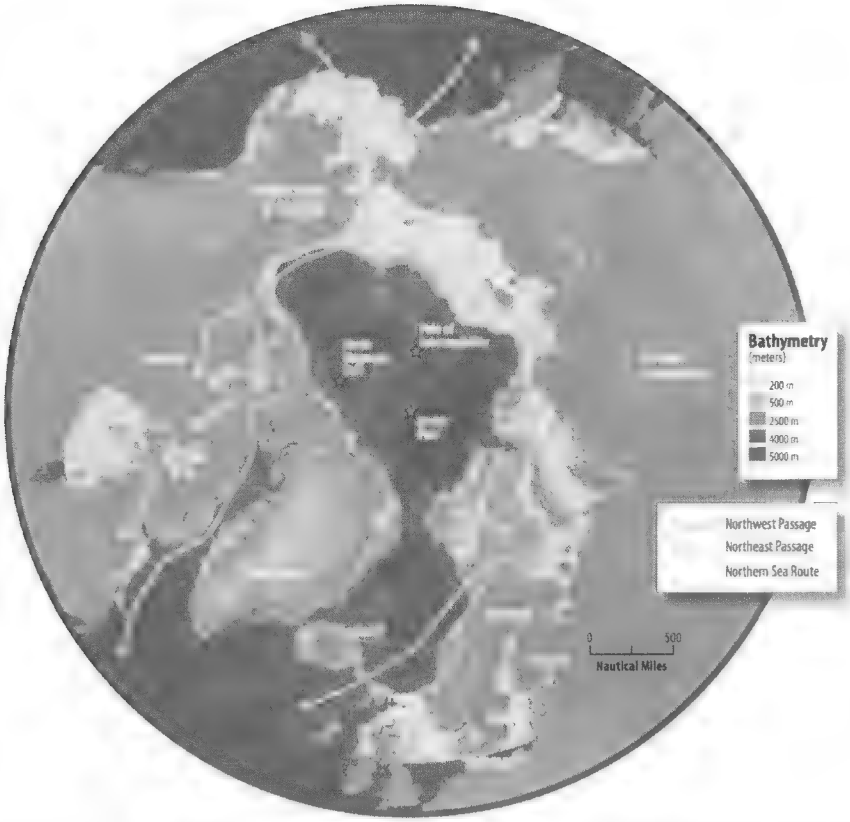

Figure 2. Northern Shipping Routes, including the Northwest Passage, Northeast Passage and Northern Sea Route. [7]

Arctic Marine Shipping Assessment 2009 Report. Arctic Council

Domestically, the Government of Canada has committed to implementing Northern Marine Transportation Corridors initiative. The main purpose of the initiative is to identify marine corridors or shipping routes within which the provision of navigational information and services will be more reliable and predictable. This approach, which would limit navigation to some 11% of Canada's Arctic Ocean, would make tackling the Arctic's immense maritime territory more economically sustainable. [8]

A few interesting facts about the Northern Marine Transportation Corridors initiative:

- From 2011 to 2013, 77% of marine traffic occurred within 5nm of the Corridors

[7] Arctic Marine Shipping Assessment 2009 Report. Arctic Council, April 2009, second printing.
[8] Marine Corridors Initiative in Canada's Arctic - General Review of Levels of Service (Program's Performance) And Engineering Studies, Canadian Coast Guard – March 2014

- From 2006-2013, 87.3% of icebreaking escorts provided were within 5nm of the Corridors
- Assuming a theoretical but realistic range adapted to each type of fixed aids, 96.2% of our Arctic fixed aids were already aligned to provide services for the Corridors
- 73.4% of marine pollution incidents were within 5nm of the Corridors
- 57.5% of SAR incidents for which the Coast Guard provided assistance were within 5nm of the Corridors

Finally, there are also expansion efforts for commercial fishery operations in a number of communities, including Pangnirtung, Cambridge Bay, Pond Inlet and Iqaluit. Each expansion effort corresponds to either additional vessels, or days at sea, and results in an increased level of risk from a SAR perspective.

1.3 **Community Support:** throughout the Arctic SAR study, the project team documented the level of community support and interest in increasing the hamlet's maritime SAR response resources. An inviting and interested community was given a rating of 'High' while a community which was not inviting or interested was given a 'Low' rating.

- Communities Rating 'High': Pangnirtung, NU; Clyde River, NU; Kimmirut, NU; Igloolik, NU; Hall Beach, NU; Grise Fjord, NU; Arviat, NU; Naujaat, NU; Coral Harbour, NU; Taloyoak, NU; Gjoa Haven, NU; Cambridge Bay, NU; Kugluktuk, NU.
- Communities Rating 'Low': None.

1.4 **Socio-Economic Conditions:** the socio-economic conditions of each hamlet were evaluated by the project team, and those that were a clean, supportive and 'safe' feeling community were given a rating of 'High', while an unsafe or unsupportive community was given a rating of 'Low'.

- Communities Rating 'High': Iqaluit, NU; Pangnirtung, NU; Qikiqtarjuaq, NU; Clyde River, NU; Pond Inlet, NU; Arctic Bay, NU; Kimmirut, NU; Igloolik, NU; Hall Beach, NU; Grise Fjord, NU; Resolute, NU; Arviat, NU; Whale Cove, NU; Chesterfield Inlet, NU; Naujaat, NU; Coral Harbour, NU; Kugaaruk, NU; Taloyoak, NU; Gjoa Haven, NU; Cambridge Bay, NU; Kugluktuk, NU.
- Communities Rating 'Low': Cape Dorset, NU.

1.5 **Infrastructure:** evaluations of the infrastructure types in each hamlet were conducted by the project team. Particular attention focussed on infrastructure needed to support maritime activities, including marine facilities. These include a wharf, boat ramp, beach (suitable for launching a vessel on a trailer), and whether any of these infrastructures were tide-limited, precluding a response at low-tide.

1.6 **Transportation access:** when examining the criterion of transportation access, this included an evaluation of the quality and frequency of transportation access available to the community, including commercial flights and via highway.

As expected, the regional transportation hubs – Iqaluit, Rankin Inlet, Cambridge Bay in Nunavut, Inuvik, NT and Kuujjuaq, QC scored relatively high, while many smaller communities with less frequent services, and limited destination options, scored lower.

1.7 **Services:** the project team completed an evaluation of the services available in each community, in order to gain a better understanding of the level of support available to a prospective maritime SAR unit. These included, determining the level of medical care within a community (i.e., hospital or health centre), as well as support services, including mechanical repair. Lastly, internet access was evaluated in order to ensure timely submission of SAR case paperwork and reports.

2. Characteristics of Marine Activity

Various characteristics or marine activity were evaluated in each hamlet, including the level and type of boating activity, a historical examination of SAR cases, the duration of the boating season, other SAR resources available within the region, and marine communication services available. These were examined to ensure that a holistic regional picture was made available, and all relevant characteristics were examined.

2.1 **Level and Type of Boating Activity:** The level and type of boating activity in each community was evaluated, and included an analysis of a number of characteristics, including:

- Size of vessels predominantly found within the community
- Condition of vessels found within the community
- Level of boating activity, and whether it was mostly local in nature, transient, or transient at distance.

2.2 SAR Case History: SAR case statistics for each community (including a 40nm response range from the community centre) were examined, and categorized based on the level of activity within the past five years (2011-2016). Communities were characterized into three categories, with the following characteristics:

- Low – less than 5 SAR cases in the previous five years
- Medium – 5-20 SAR cases in the previous five years
- High – More than 20 SAR cases in the previous five years

2.3 Duration of the Boating Season: the duration of the boating season was also documented, and included the time from ice-out to ice-in. An extended boating season is seen as a risk factor, when compared to a shortened boating season. Other risk factors evaluated included: tides, currents, level of charting, and nearest safe havens and places of refuge. Those communities with longer boating seasons, or higher tides, fewer locations of refuge or poor quality charts were generally determined to have a higher level of risk.

2.4 Other SAR Resources: included an evaluation of the other SAR resources that may be available in the area, including Civil Air Search and Rescue Association (CASARA), the Royal Canadian Air Force, or other existing maritime or air search and rescue associations was completed.

2.5 Communications: an assessment of the communications capabilities within the hamlet and surrounding waters was carried out. This included verification of whether maritime VHF radio (Channel 16) was available, and provided by the CCG or by the community, and or whether there are alternate communication measures generally utilized by the community. Additional means of communication, including MF and HF were also documented.

SARRA Coast Guard Community Engagement

Baffin Island Trip Report – James Hare

Coast Guard's Search and Rescue Risk Analysis team travelled to Baffin Island January 30 – February 3. The purpose of this trip was to evaluate the need for SAR assets, boater education, address community concerns, and confirm historical and future human, geographical, and climate factors in each community. The SARRA team met with community elders, CCGA units, Rangers, Guardians, fishermen, CASARA spotters, mayors, and youth to discuss these issues.

The vast majority northerners use vessels. Mostly to hunt, trap, gather, transit to other communities, and fish. Typical vessels range from 18' to 26'. Silver Dolphin is the most common brand, with a metal hull, room for two outboard motors on the transom, high freeboard, and most having custom-built cabins made of plywood. Open 'canoe' style vessels are also popular; with wooden construction, narrow beam, and shorter LOA's.

SARRA found that on a nice day, at least 20% of a community's vessels can be expected to be on the water at any one time. In total; Arctic Bay has 50 small craft, Pond Inlet has 300, Pangnirtung has 150, and Qikiqtarjuaq has approximately 100.

Arctic Bay, Pangnirtung, and Qikiqtarjuaq reported minimal issues with merchant cargo and fuel operations. Pond Inlet raised the issue of SONAR use from cruise ships, ore, cargo, and fuel vessels disturbing marine wildlife. As a result, hunters and fishermen travel further away from the hamlet in order to find food, thus increasing risk through prolonged exposure. Pond Inlet reported an increase in large vessel traffic in the past 5 years. Pangnirtung reported no change, Qikiqtarjuaq reported an increase, and Arctic Bay reported an increase, especially of pleasure craft sailboats transiting the NWP. The community sees between 5 and 7 sailboat yachts per season making the transit.

Small craft of 18' to 28' reported regularly transiting 100-150nm between communities along exposed shorelines.

All communities mentioned frustration with the lack of CHS marine charts available. They prefer to use charts over relying on local knowledge. During meetings, elders asked if they could keep the charts that SARRA brought in, as these publications are difficult to come by in the north. Recommendations were made to include charts as a future engagement gift, as they serve a practical purpose. Perhaps JRCC contact information could be included on these documents.

All communities had a centralized VHF tower, with plans for developing up to 2 additional repeater stations to increase reception. These towers are not linked to MCTS Iqaluit. It is recommended that steps be taken to allow Iqaluit to monitor community VHF towers for offering services such as sail plans, marine weather, issuing MARB's, and coordinating searches with JRCC.

Statistics and Facts:

Fact	Remarks
Arctic Bay has 50 small craft Pond Inlet has 300 small craft Pangnirtung has 150 small craft Qikiqtarjuaq has ~100 small craft	Most vessels are 18' to 26', of open-hull, metal construction with custom (home) made cuddy cabins in the bow made from plywood.
Arctic Bay sees 5 to 7 pleasure sailboats transiting the NWP each season. This number has been increasing in recent years.	"some are well equipped, some are not at all", reported the mayor of Arctic Bay. Sailboats bring headaches and economic boost to the community.
Many Qikiqtarjuaq boaters have SVOP and MED-A3 qualifications due to experience working in commercial fisheries	The same is true for many communities on the east coast of Baffin Island.
When weather is poor, small craft are more likely to seek shelter nearby (including travelling further away from the hamlet) instead of returning to the community. The longest anyone has done this is for a duration of 8 days in a vessel.	The definition of "nearest safe haven" essentially means "nearest sheltered inlet" for boaters in the north. Usually a cabin is used for refuge.
When weather is good, it is typical for 30 vessels to leave Pangnirtung and fish in the nearby inlets. This is 20% of the vessels in the community.	This figure is realistic for other communities, as well.
Whenever a large pod of narwhales are spotted near Qikiqtarjuaq, it is typical for the entire community to launch all their boats to observe the spectacle. Hunting, viewing, and otherwise socializing happens as the community brings in the catch. This amounts to 110 vessels going on-water in a short period of time.	This type of surge vessel activity behavior is notable due to the increased demand it places of the SAR system for a short period of time.
Pond Inlet is constructing a deep water wharf for cargo and cruise vessels.	While the community is not thrilled by the SONAR use of cruise vessels, they do see an economic future as a cruise ship hub.
Qikiqtarjuaq has proposed a deep water port facility, with SAR resource facilities included in the planning.	This proposal was seen prominently displayed at the airport, for visitors to view. Funding has not been secured for this project yet. The community's ambition is remarkable and demonstrates a strong interest in partnerships with the federal government.
Pang has a Small Craft Harbor with floating docks. It is tide-dependent.	Built in 2000's, the harbor contains approximately 100 vessels.
Arctic Bay is extending the breakwater for their small craft harbor in 2019 or 2020, tripling capacity.	The starting date was unclear, as it is typical for civil engineering projects to experience delays.
SONAR use disturbs marine wildlife in Qikiqtarjuaq and Pond Inlet	This topic is well studied by scholars.
45ft waves have been reported in Davis Strait from Qikiqtarjuaq community members	These observations were made aboard offshore fishing vessels such as F/V Saputi.

Transiting across Cumberland Sound is dangerous unless the waters are flat calm. Heavy seas and strong current make the transit hazardous.	When the seas whip up, locals take a longer route which follows the shoreline closely, using island as barriers whenever possible.
Common small craft transits include: Qikiqtarjuaq – Pang – Iqaluit, Qikiqtarjuaq – Clyde River, Pond – Arctic Bay and return.	These routes range from 100-150nm and take from 8-18 hours of boating to complete.
LESS THAN ½ OF CASES ARE REPORTED TO FEDERAL SAR SYSTEM	Pending confirmation from RCMP and Nunavut EMO statistics
CCG has a Memorandum of Understanding in most communities that RCMP will perform SAR where CCG assets not present.	Is the CCG responsible for SAR outcomes when RCMP responded? Is RCMP expected to meet CCG performance indicators while performing the role of the CCG.
Communities perform coordinated SAR operations without the assistance of JRCC, NEM/ EMO, and RCMP.	This is especially true in Arctic Bay, where the Guardian program coordinates their own searches.

Community Issues Raised:

Issue	Impact	Response
Sonar use from merchant, mining, and cargo vessels.	Hunters travel further away from communities in order to harvest marine wildlife whenever commercial vessels are in the vicinity. Longer trips, more exposure to the elements, and hazards associated with boating in the north increase the risk of such voyages.	In Pond Inlet, limit cruise, cargo, ore, and merchant traffic to entering and exiting only one side of Eclipse Sound. Limit through access.
Sailing vessels disrespecting Inuit cultural sites, disrupting wildlife.	Local hunters, elders, inuit are frustrated with this behavior. Soured relationships between passing travelers and locals jeopardizes the integrity of a community-operated SAR unit's willingness to aid a sailboat in distress. Similarly, any enforcement imposed by marine assets will discourage sailboats from seeking help from Arctic Bay hamlet.	1. RCMP involvement 2. Boater Education
Elders in Pond Inlet explained how slow response times has resulted in the deaths of 2 young men in 2000 after a vessel capsized.	Slow response times in community SAR assets limits the effective range of providing life-saving PIW retrieval during the 1 hour which a typical person will remain alive in zero-degree water. Boaters not wearing a flotation device will drown within 10 minutes, while someone with flotation will become unconscious after 60 minutes.	1. Increase survival time of boaters in distress Fund Canadian Safe Boating Council campaigns such as Operation Life Preserver. Provide boater education on the effects of cold water, HELP position, and distribute life jackets and floater suits. Distribute buoyancy tanks for installation in small craft so they do not sink when swamped/ capsized. 2. Decrease response time of SAR assets Implement seasonal Inshore Rescue Boat Station in Pond Inlet. (15min reaction time, vessel speed of 30kts = 1hr range of 22.5nm) Provide small craft with loanable AIS/ Inreach/ SPOT

		devices to minimize search time.
Need for community to have system to monitor their vessels while doing SAR, such as AIS, GPS, or InReach tracking.	Lack of knowledge on an overdue/ distressed vessel's last known position greatly lengthens the time and resources required to complete a search.	Iqaluit MCTS link to community towers. Sail plan filing, SPOT device loans. JRCC to provide SITREPS to hamlet office upon request.
Qikiqtarjuaq directly inquired about having a CCG base/ office in the hamlet	Economic boost to community, increased on-water safety and prevalence, boater education.	SAR assets are recommended for placement based on assessed need. Environmental Response, Fisheries, and CCGA are alternative routes to have a Coast Guard/ DFO facility staffed in the community.
Elders and CCGA reported young people are being irresponsible with boating. Taking on higher risk, departing in poorer weather	Increased likelihood of SAR event, loss of life, community grief. Possible higher economic output of town due to increased time spent fishing/ hunting. Higher wear on vessel equipment.	Boater education
Young people are encouraged to use larger vessels to handle large seas	Higher cost to purchase larger vessels, more borrowing/ sharing of vessels.	Young people may also benefit from getting involved directly with volunteer CCGA groups. It allows them to operate larger vessels in poor weather with the proper safety equipment.
Coast Guard has not (historically) recovered snowmobiles on adrift ice floes during rescue. Snow machines are not insured.	Property loss, economic hardship for the owner of the vehicle, frustration towards coast guard for lack of response. Inquiry as to whether the coast guard will pay for abandoned snow machines.	Coast Guard prioritizes saving lives over property.

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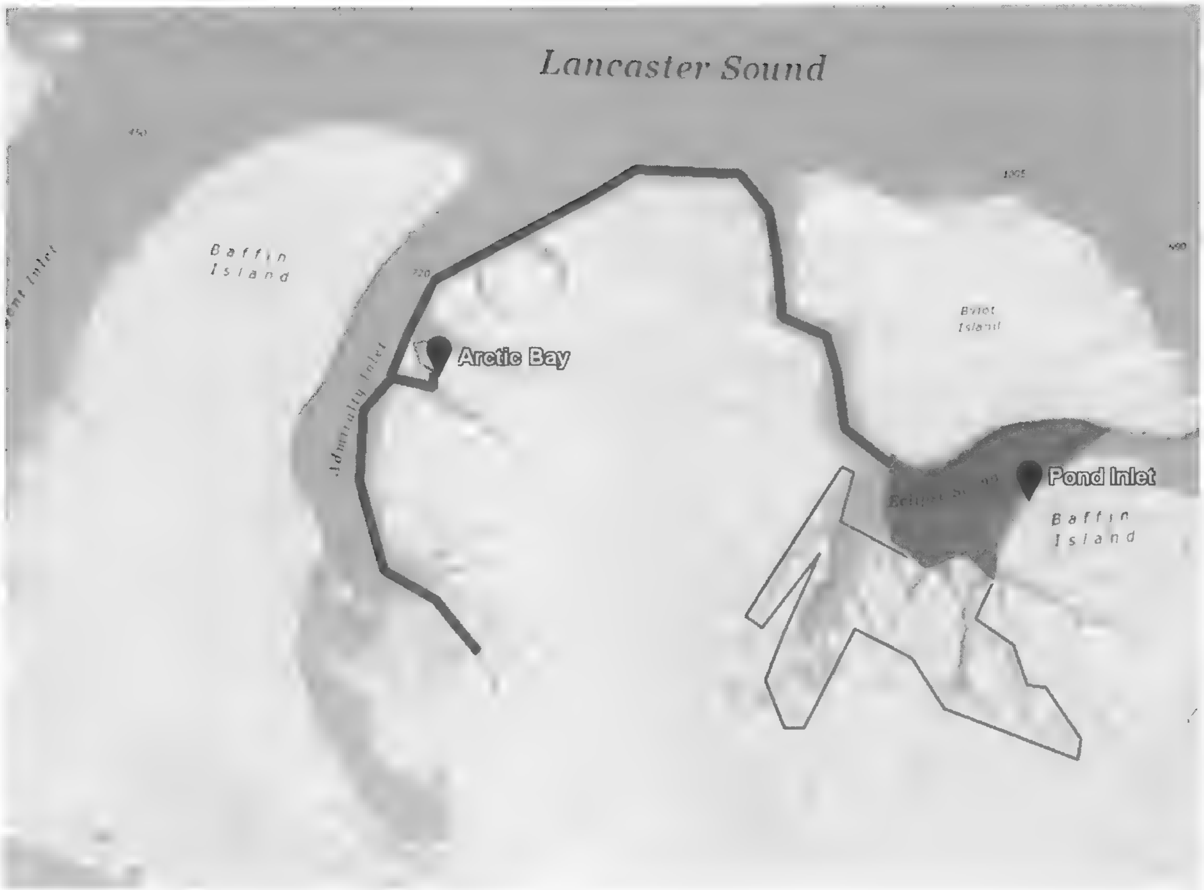
Figure 1 When it comes to community engagement, every opinion counts!

Local Knowledge



Travel between Pond Inlet and Arctic Bay using small craft is well established. The route is approximately 210 nautical miles long. The fastest time for completing this route is in 6 hours at a speed of 35kts. A small craft making 20kts average speed would complete this journey in 10.5 hours of travel time.

Cabins are popular in both communities, with Pond Inlet residents mostly setting up near the hunting grounds SW of the community adjacent to Sirmilik National Park, on Nunavut Land Claims Agreement territory. In Arctic Bay, many residents set up camp to the north of the hamlet in the adjacent bay.

When merchant vessels carrying ore, cargo, fuel, and passengers enter Eclipse Sound, Inuit hunters are forced to travel away from the source of SONAR underwater noise pollution. Hunters leave the relative safety of Eclipse Sound and harvest in Lancaster Sound and Davis Strait, instead. This leaves them more exposed to inclement sea conditions. SONAR disrupts marine wildlife as it operates on the same frequency as many marine mammals are able to communicate on. The hunting of whales, seal, and narwhale is affected.

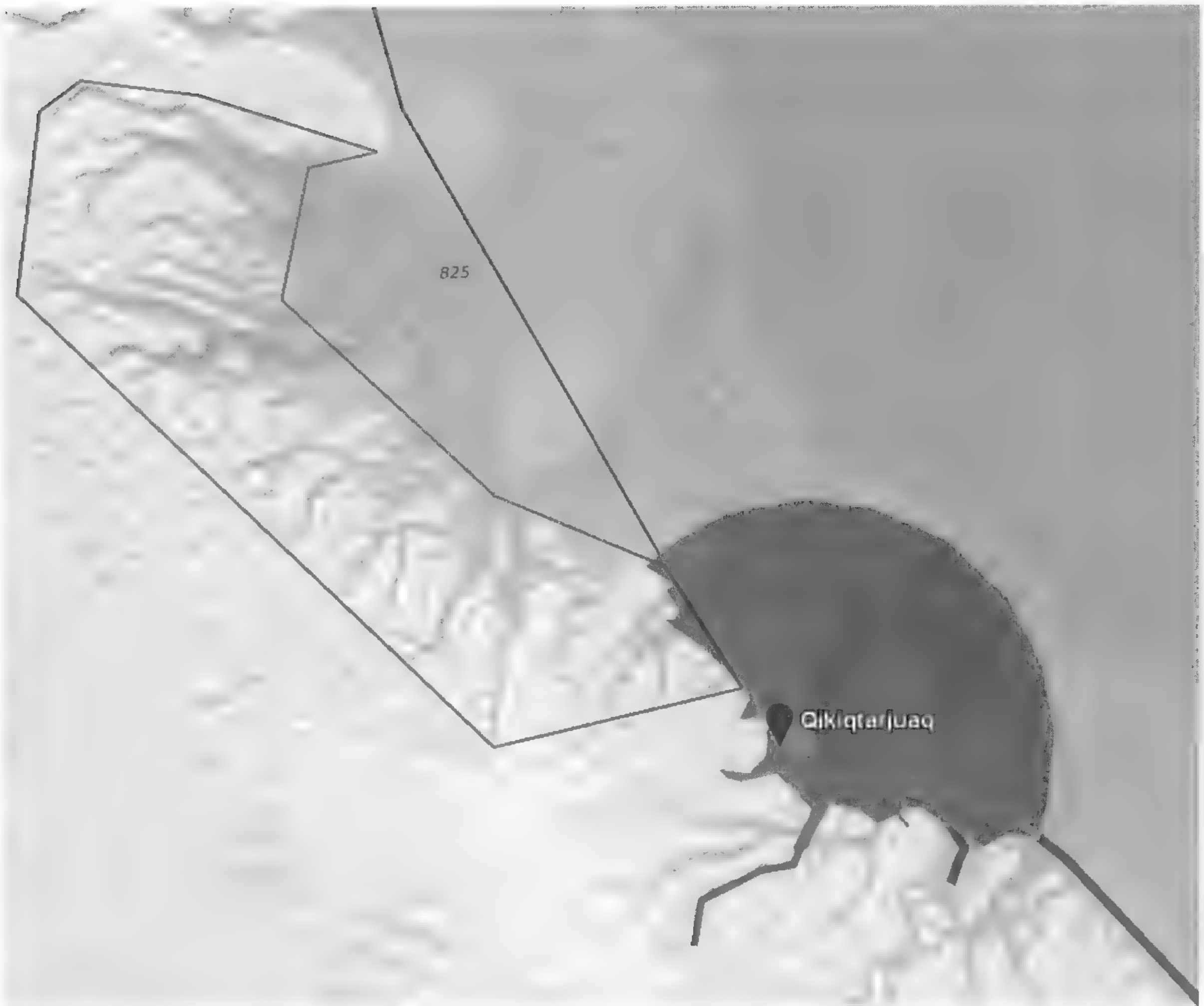
Arctic Bay has seen an increase in the number of transient sailboats entering the community in the last 5 years. The hamlet reported instances of negative interactions where yacht crew entered NLCA Inuit historical sites without permission as well as discharging firearms towards flocks of birds for entertainment.

Pangnirtung residents reported strong currents in the NW corner of Cumberland Sound along with frequent heavy seas entering the sound from Davis Strait. Currents were sufficient enough to leave open water ice leads well into January, which the community uses for hunting. Cabins are mostly located on the SW shoreline, notably out of range from reported VHF coverage.

Transits to Iqaluit are common. The distance over water is approximately 375nm. One resident reported completing such passage on a 16' skiff. Walrus and Caribou hunting occur along this route in the summer. Similarly, the 325nm transit to Qikiqtarjuaq is not out of the ordinary for a hunting trip.

VHF covers approximately 2/5 of Cumberland Sound. Two VHF towers exist with plans for a third repeater station to increase range into Kingnait Fiord, the neighboring inlet to the SE of Pangnirtung.

Most fiords in the area are popular fishing spots. Kingnait is especially popular due to its proximity to the hamlet. Fishing is typically an all-day event. Hunting is typically a multiple night trip.



Qikiqtarjuaq residents enjoy cabins mostly to the north of the community. Near the hamlet, small and medium sized vessels conduct commercial fishing in the waters near shore. Catch is typically Arctic Char and Turbot. The Hunters and Trappers Association in Qikiqtarjuaq has constructed several emergency cabins along the coast where stranded individuals can seek refuge from predators and inclement weather.

Fishing is popular in all directions from the community, including the inlets to the south. The Labrador Current moves sea ice and calved glaciers past the community towards southern waters. Residents of Qikiqtarjuaq reported making occasional trips to Clyde River, but noted that it is not as popular as going to Pangnirtung. Concern over risk incurred via transiting long stretches of open ocean was the primary reason for infrequent trips to Clyde River.

VHF coverage does not encompass all areas where boaters travel to. The lack of AIS tracking, sail-plan services, vessel tracking under 300grt, and vast distances between communities makes boating in the north an isolating experience.

During engagement, boaters expressed a need for updated charts, better shoreline surveying, and distribution of charts to mariners. Community members explained that it is challenging to get charts shipped to the arctic. Local knowledge is a critical component of the current risk-awareness and navigation techniques used by Inuit. All those who engaged with SARRA had excellent spatial awareness and pointed out detailed features on charts with no prior exposure to paper charts.

ANNEX # 1 CCG ARCTIC SAR PROJECT: COMMUNITY VISITS (Chronology)

GCCMS#: 2017-412-00011
EKME # : 3764792

Date	Communities	Participants
2015/16		
October 201	Kangirsuk, Kuujjuaq	Mark Gagnon
December 6-11, 2015	Kangirsuk, Pangnirtung, Clyde River, Cape Dorset, Igloolik	Peter Garapick, Mark Gagnon, Tara Bellefontaine, Adam Erland
February 2-7, 2016	Kuujjuaq, Kangiqsujuaq, Inukjuaq, Kangirsuk, Kuujjuarapik, Puvirnituq	Peter Garapick, Mark Gagnon, Michel Lefebvre, Craig Lingard, Andre Audet
March 9-10, 2016	Arctic District Meeting, Whale Cove, Arviat, Rankine Inlet	Mark Gagnon, JP Sharp, Shannon Laird, Brenda Panipakoocho
February 24, 2016	Kitimat Regional Government Mayors' Meeting, Kujjuaq	Peter, Mark, Harvey Vardy, Louis Melacon, Andre Audet
March 21-24, 2016	Whale Cove, Arviat, Rankine Inlet, Gjoa Haven, Kugaaruk, Iqaluit	Mark Gagnon, JP Sharp, Shannon Laird, Brenda Panipakoocho
March 21-27	Arctic Bay, Gjoa Haven, Kugaaruk, Iqaluit (***This was on flip chart twice March 21-24 and March 21-27)***	
2016/17		
June 22-26, 2016	Churchill	Mark Gagnon, Phil Walker, Peter Garapick
July 18-22, 2016	Ivujivik, Salluit, Kangirsuk, Quaqtaq, Kuujjuaq	Mark Gagnon
October 17-21, 2016	Inuvik, Aklavik, Sachs Harbour, Tuktoyaktuk, Ulukhaktok, Paulatuk	Peter Garapick, Mark Gagnon, Shannon Laird, Cathy Sandiford (MJ Martel – RCMP NWT in Tuk)
November 14-18, 2016	Qikiiqtarjuaq, Clyde River, Pond Inlet, Grise Fiord, Resolute, Igloolik (touch down), Iqaluit	Peter Garapick, Harvey Vardy, Chris Elliot, Cathy Sandiford
November 28-December 2, 2016	Kuujjuaq Mayors' meeting Tasiujaq (helicopter side trip: Peter and Jennifer)	Peter Garapick, Mark Gagnon, Jennifer Horsman, Andre Audet, Louis Melacon, Pierre Lefebvre, Vincent Meunier, Cathy Sandiford
January 9-13, 2017	Inuvik, Ulukhaktok, Kugluktuk, Cambridge Bay	Peter Garapick, Mark Gagnon, Cathy Sandiford, Adam Biehler
January 29-February 7, 2017	Iqaluit, Kimmirut, Coral Harbour, Naujaat, Cape Dorset, Taloyoak, Hall Beach, Igloolik, Chesterfield Inlet	Peter Garapick, Mark Gagnon, Cathy Sandiford, Shannon Laird, Darlene Langdon
February 29-March 2, 2017	Tasiujaq, Umiujaq, Akulivik, Aupauluk, Kangiqsualujjuaq (Nunavik); Sanikiluaq, Sanikiluaq (Nunavut)	

Participants by organization: (will refine this later)

CCG: Peter Garapick, Mark Gagnon, JP Sharp, Tara Bellefontaine, Harvey Vardy, Jennifer Horsman, Adam Erland, Adam Biehler, Cathy Sandiford

CCGA-Central Arctic: Shannon Laird, Darlene Langdon

CCGA- Quebec: Louis Lefebvre,

Government of Nunavut: Brenda Panipakoocho

Kativik Regional Government, Nunavik Craig Lingard, Michel Martin DND: Vincent Meunier

CCG ARCTIC SAR PROJECT: Community CGA SAR Unit Status

Northwest Territories		Nunavut		Nunavik, Quebec	
1. [redacted] 2. [redacted] 3. Paulatuk 4. Sachs Harbour 5. [redacted] *Yellowknife and Hay River have established CGA SAR Units but are not captured here as they are not located on the Arctic Ocean.		*Kitikmeot Region* 1. [redacted] 2. [redacted] 3. **Kugaaruk** (Pelly Bay) 4. [redacted] (Coppermine) 5. **Taloyoak** (Spence Bay) *Kivalliq Region* [redacted] 2. **Baker Lake** 3. **Chesterfield Inlet** 4. **Coral Harbour** [redacted] 6. **Naujaat** (Repulse Bay) [redacted] *Qikiqtaaluk Region* 1. **Iqaluit** 2. **Arctic Bay** 3. **Cape Dorset** 4. **Clyde River** 5. **Grise Fiord** 6. **Hall Beach** 7. **Igloolik** [redacted] 10. **Pond Inlet,** 11. **Qikiqtarjuaq,** 12. **Resolute** 13. **Sanikiluaq**		1. **Akulivik** 2. **Aupaluk** 3. **Inukjuak** 4. **Ivujivik** 5. **Kangiqsualujjuaq** 6. **Kangiqsujuaq** [redacted] 8. [redacted] (administrative centre) 9. **Puvirnituq** 10. **Quaqtaq** [redacted] 12. **Tasiujaq** 13. **Umiujaq** 14. **Kuujjuarapik**	
6 communities		25 communities (including Baker Lake)		14 communities	

[redacted] – Existing CGA Unit pre 2016

[redacted] – New CGA Unit 2016/17

Yellow – pending CGA Unit 2017

Grey – near future CGA Unit

**Some Yellow and / or Grey shaded communities may become or not become CGA SAR Units as anticipated due to unexpected factors and influences.

Canadian Coast Guard Arctic Search and Rescue (SAR) Project - Partnering with Coastal Communities to Enhance Arctic SAR Capacity -

Engagement across 45 coastal Arctic communities to identify marine risks and associated trends, risks and challenges from the perspective of Search and Rescue and opportunities to build community-based SAR capacity across the Arctic, bringing skills, knowledge and expertise of community members into the CCG SAR family.

A. Introduction

The Canadian Coast Guard (CCG) undertook the Arctic SAR Study as part of a broader strategy to enhance maritime safety and emergency preparedness in the Arctic. This study was initially framed as a two-year review of marine risks and SAR requirements in coastal Arctic communities. However, the scope of the project evolved to incorporate two additional sub-initiatives:

1. Development of, and support to, existing marine SAR resources operating in Arctic communities as CCG Auxiliary SAR Units;
2. A preliminary analysis of existing vessel capacity in communities, used to inform the decision criteria for CCG investment in community boats.

When funding was announced for these initiatives, the Arctic SAR Study project team moved quickly to integrate all three elements, with dedicated intensive efforts carried out in the final half of fiscal year 2016/17. Ultimately the project seeks to achieve an improved approach to engagement with coastal communities, an improved SAR preparedness and response, and align directly with the priority areas of the Government of Canada's Oceans Protection Plan.

B. Background

The Canadian Arctic represents unique challenges in for search and rescue, especially in light of increasing traffic (both pleasure craft and commercial) and their associated risk. Maritime safety and SAR capacity is a priority for the CCG.

The CCG is working with the Canadian Coast Guard Auxiliary (CCGA) and other SAR partners to expand the network of Arctic CCGA units of community volunteers with compliant vessels across the region. CCGA units are an important component of the Canadian maritime SAR strategy, and create a network of strong partnerships and engaged coastal communities, while also heightening the awareness of the SAR system.

The Arctic SAR Study had three components and inter-related objectives:

i. Identify marine risks and SAR requirements in coastal Arctic communities;
ii. Identify and act upon opportunities for expanding response capacity through the establishment of new units and enhanced support to existing units;
iii. Conduct preliminary assessment of communities to from the perspective of potential candidates for investment in community boats to inform and assist with the development of decision criteria.

- CCG receiving additional $1 million in operational funding annually for CCG Auxiliary in Arctic and $1 million annually for four years to purchase vessels as community-owned CCG Auxiliary SAR units.

C. Methodology

The Arctic SAR Study was carried out using principles of the CCG's Risk-Based Analysis of Maritime SAR delivery (RAMSARD)[1] with a focus on identifying marine risks and SAR requirements in coastal Arctic communities.

The RAMSARD Manual outlines a six-step process that is aligned with the CSA's Q850-97 Risk Management: Guidelines for Decision-Makers. The six steps are: Initiation, Risk Identification, Risk Estimation, Risk Evaluation, Risk Control, and Action and Monitoring. The focus and objectives of each step are as follows:

1. **Initiation**

The Initiation step is arguably the most important step, as it represents the planning phase of the analysis to be undertaken. This step includes defining objectives and the reason(s) for the analysis, as well as identifying related issues, the project team, resources, responsibilities and scheduling.

2. **Risk Identification**

The Risk Identification step represents a major decision point for a routine application of the RAMSARD process as it identifies the existing SAR response risks in the Area under review and defines the scope of any risk 'problem' to be dealt with (or establishes that the existing risks are being adequately mitigated). The existing risks are described in the form of risk scenarios, which are a defined sequence of events with an associated likelihood of occurrence and a range of potential impacts. Initial stakeholder consultation and analysis as well as a fairly detailed Preliminary Analysis will also be undertaken during this step. If the Preliminary Analysis determines that existing risks are assessed as being adequately mitigated and no new risks or management decisions need to be dealt with, the analysis can be ended at this point.

3. **Risk Estimation**

The Risk Estimation step consists of estimating the likelihood and consequences associated with Risk Scenarios identified during the Risk Identification step.

4. **Risk Evaluation**

The Risk Evaluation step involves evaluating whether the identified risks are acceptable or not in terms of the benefits of the activities leading to the risks, and the needs, issues and concerns of stakeholders, including CCG. If the risks are considered acceptable at their current levels, the analysis can be ended at this point.

5. **Risk Control**

The Risk Control step involves identifying and evaluating measures to reduce the likelihood or the consequences of the risk scenarios previously identified. The measures considered must include all available SAR response capabilities, not merely CCG resources. The effectiveness of each measure will be estimated and any remaining residual risk will be evaluated as to its acceptability; if risks are considered acceptable with the application of selected measures, the analysis may be ended.

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[1] Canadian Coast Guard. Risk Based Analysis of Maritime Search and Rescue Delivery. EKME#2696593

6. Action and Monitoring

Action and Monitoring involves implementing the risk control measures identified to reduce the risk(s) and then measuring the effectiveness of these measures to confirm that the risk(s) have been reduced to an acceptable level. If not, the Risk Control step needs to be re-visited to identify and evaluate alternate or additional measures to reduce the level of residual risk to an acceptable level. If the measures are confirmed as having been effective, then no further action (except continued monitoring) is required and the analysis process is complete.

Note

The aeronautical and maritime SAR system differs from many risk analysis and decision-making situations for which the CSA Q850 was intended, in that, an ongoing but informal state of consultation with stakeholders and monitoring of system effectiveness exists. As a result, there will likely be no great revelations during an application of the RAMSARD process; however, in terms of detail and methodical analysis, the routine, 5-year application of RAMSARD will provide a more formal and comprehensive review of SAR Area risks and the effectiveness of SAR response in mitigating them.

The RAMSARD methodology was designed to address the project's three inter-related objectives, while capitalizing on synergies in community engagement. In keeping with guiding principles articulated in the project charter, the engagement in the 44 communities visited focussed on two key elements;

1. Determining the ability for communities to easily become CCGA members in their community. This includes verification of the required elements to become a functioning unit – i.e., vessel, crew, administrative support, and;
2. Determination of the additional requirements needed to become part of the SAR system, if the community does not currently have the capacity to join CCGA (i.e., vessel requirements, demonstrated marine risks in the community etc.)

With elements in mind, the Arctic SAR Project was designed to make visits to Arctic communities across the Northwest Territories, Nunavut and Nunavik to:

- Meet and establish relationships with community members
- Present information on the CCG activities and services in the Arctic and the plan for expanding SAR capacity through engaging community volunteers to form CCG Auxiliary units.
- Educate and inform on the benefits of becoming members of the CCG Auxiliary and establishing community-based Auxiliary Units
- Research, learn and gather facts about the communities, with a particular focus on boating activities, boat capacity, level of community-wide boating safety awareness and marine risks.
- Specifically, the RAMSARD approach used in the Arctic SAR Study evaluated a number of factors including the following:
  - Population of hamlet
  - Number of boats in hamlet
  - Level and nature of on-water activates in hamlet (hunting , fishing, pleasure, distance)
  - Waters of hamlet – stable or dynamic, open or sheltered
  - Weather conditions – stable or dynamic
  - Duration of ice-free waters
  - Climate change impacts – do fishers, hunters have to travel further, are water conditions harsher due to less ice coverage or more broken ice in waters
  - Industry changes – growing or shrinking tourism , commercial fishery, mining, adventure boaters;
  - SAR Society – does hamlet have an established and organized SAR group
  - Enthusiasm of community and people – does the council support, do the people support
  - Is there, are there appropriate/suitable vessels available in community for use in an Auxiliary vessel
- Present the opportunity for a partnership with the CCG through membership in the CCG Auxiliary
- Identify community leaders for follow-up
- Establish next steps and plans for follow-up with each community

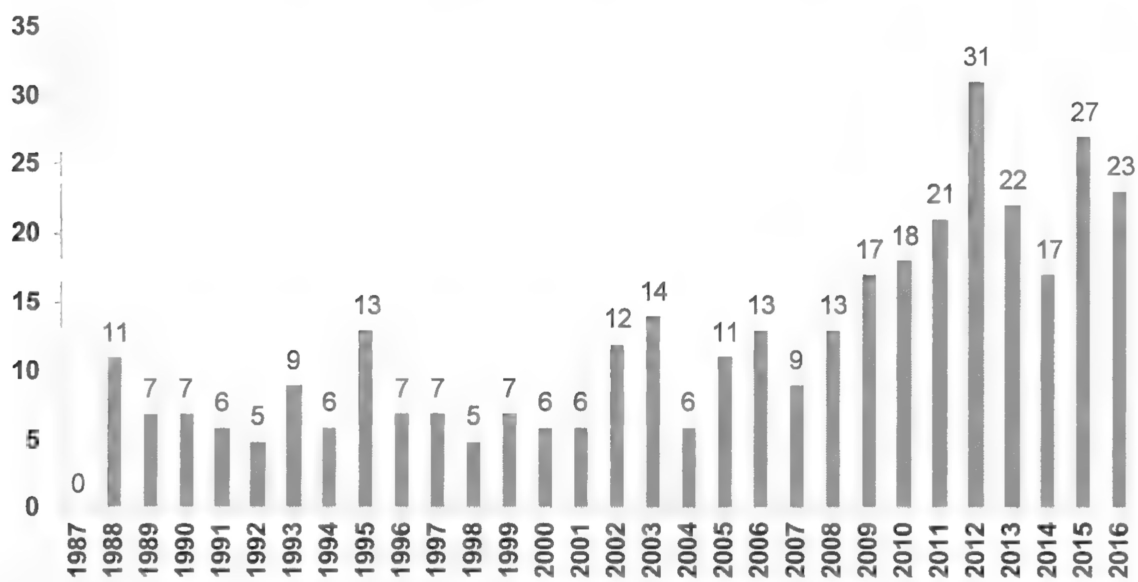
D. The Arctic: On Overview *(Situating area under review, the communities engaged – high level)*

- Overview of region from perspective of its people, geography, coastal waters activities, government structures, relationships and linkages across communities
- Sparse populations located at great distances from each other
- Coastal communities largely Inuit – over 90 per cent Inuit in most cases.
- Community structures – coastal communities with different raison d'être – community relocation in the 1950s brought people from traditional hunting camps to live in one community e.g. Paulatuk surrounded by many camp in hunting grounds where people had traditionally lived. Now community members have to boat to those hunting grounds.
- Culture and languages
- Long transit times between port facilities and vessels
- Changing marine risks and implication for safety

E. The Arctic: Maritime Picture *(Risk estimation)*

Activity in the Arctic is on the rise. This activity includes an increase in resource development on-shore, coupled with an increase in marine activity via cruise ships, ecotourism and adventurer operators. The following charts and tables depict the number of full and partial transits of the Northwest Passage, as collected by NORDREG.[2]

Full Transits of the Northwest Passage:



The following table depicts a summary of the full transits of the Northwest Passage completed in 2016:

[2] The following vessels are prescribed as classes of vessels for the purposes of subsections 126(1) and (3) of the Canada Shipping Act in respect of the NORDREG Zone:

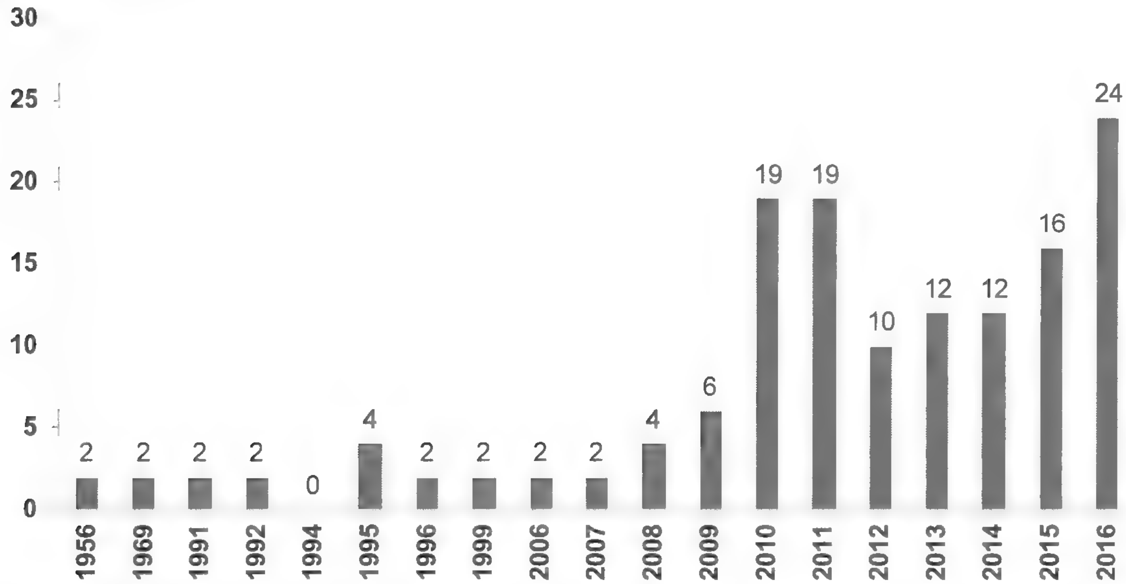
- **(a)** vessels of 300 gross tonnage or more;
- **(b)** vessels that are engaged in towing or pushing another vessel, if the combined gross tonnage of the vessel and the vessel being towed or pushed is 500 gross tonnage or more; and
- **(c)** vessels that are carrying as cargo a pollutant or dangerous goods, or that are engaged in towing or pushing a vessel that is carrying as cargo a pollutant or dangerous goods.

YEAR INITIATED	YEAR COMPLETED	NAME OF VESSEL	IDENTIFICATION	FLAG	TYPE OF VESSEL	VESSELS CHARACTERISTICS	FULL OR PARTIAL	DIRECTION	ROUTE
2016	**2016**	**Africaborg**	IMO 9365661	Netherlands	General cargo	143.00m X 22.00m - 10,530 HP - 11,864 GRT	Full	West to East	Bellot Strait
2016	**2016**	**Agar II**	N/A	British Virgin Islands	Adventurer	20.00m X 6.00m	Full	West to East	Bellot Strait
2016	**2016**	**Amundsen (CCGS)**	IMO 7510846	Canada	CCG Icebreaker	98.15m X 19.50m - 13,793 HP - 5,911 GRT	Full	East to West	Peel Sound
2016	**2016**	**Amundsen (CCGS)**	IMO 7510846	Canada	CCG Icebreaker	98.15m X 19.50m - 13,793 HP - 5,911 GRT	Full	West to East	McClintock Channel
2016	**2016**	**Bonavalette**	N/A	Switzerland	Adventurer	35 ft sailboat	Full	East to West	Peel Sound
2016	**2016**	**Breakpoint**	N/A	Germany	Adventurer	14.40m X 4.00m	Full	East to West	Bellot Strait
2016	**2016**	**Caledonia**	N/A	Germany	Adventurer	60 ft X 16 ft	Full	West to East	Bellot Strait
2016	**2016**	**Crystal Serenity**	IMO 9243667	Bahamas	Passengers ship	250.00m X 32.30m - 70,470 HP - 68,870 GRT	Full	West to East	Bellot Strait
2016	**2016**	**Eagles Quest**	N/A	Hong-Kong	Adventurer	Tayana 58 DS - 16m X 6m	Full	West to East	Bellot Strait
2016	**2016**	**Galileo G**	IMO 9631814	United Kingdom	Pleasure craft	56.00m X 10.00m - 1,575 HP - 726 GRT	Full	East to West	Peel Sound
2016	**2016**	**Happy Rover**	IMO 9139309	Netherlands	Heavy lift ship	138.00m X 23.00m - 11,846 HP - 10,990 GRT	Full	West to East	Belot Strait and Fury and Hecla Strait
2016	**2016**	**Hetairos**	N/A	Cayman Islands	Pleasure craft	66.70m X 10.50m	Full	East to West	Peel Sound
2016	**2016**	**Kapitan Khlebnikov**	IMO 7824417	Russia	Passengers ship	129.42m X 26.70m - 24,840 HP - 12,288 GRT	Full	East to West	Prince of Wales Strait
2016	**2016**	**L'Austral**	IMO 9502518	France	Passengers ship	143.00m X 18.00m - 6,254 HP - 10,944 GRT	Full	East to West	Bellot Strait
2016	**2016**	**Louis S. St. Laurent (CCGS)**	IMO 6705937	Canada	CCG Icebreaker	119.80m X 23.28m - 27,393 HP - 11,345 GRT	Full	West to East	Belot Strait and Fury and Hecla Strait
2016	**2016**	**Maewan 4**	N/A	France	Adventurer	Sailboat	Full	East to West	Bellot Strait

2016	**2016**	**Manevai**	N/A	France	Adventurer	14.30m X 4.32m aluminium	Full	East to West	Peel Sound
2016	**2016**	**Nomad**	N/A	Austria	Adventurer	N/A	Full	East to West	Peel Sound
2016	**2016**	**Northabout**	N/A	United Kingdom	Adventurer	14.00m X 2.00m	Full	West to East	Bellot Strait
2016	**2016**	**Pachamama Toptoptop**	N/A	Switzerland	Adventurer	15.28m X 4.54m alumimum	Full	West to East	Bellot Strait and Fury and Hecla Strait
2016	**2016**	**Polarbound**	N/A	United Kingdom	Adventurer	14.6m trawler yacht	Full	East to West	Fury and Hecla Strait and Bellot Strait
2016	**2016**	**Ratafia**	N/A	France	Adventurer	10.20m X 3.52 alumimum ketch - Renault Couach 20 HP engine	Full	East to West	Peel Sound
2016	**2016**	**Yvinec**	N/A	France	Adventurer	Sailboat	Full	East to West	Peel Sound

The following chart and table depict the number of partial transits of the Northwest Passage, as collected by NORDREG.[3] A partial transit westwards is considered as far west as Cambridge Bay and a partial transit eastwards is considered as far east as Resolute Bay.

Partial transits:



The following table depicts a summary of the partial transits of the Northwest Passage completed in 2016:

[3] The following vessels are prescribed as classes of vessels for the purposes of subsections 126(1) and (3) of the Canada Shipping Act in respect of the NORDREG Zone:

- **(a)** vessels of 300 gross tonnage or more;
- **(b)** vessels that are engaged in towing or pushing another vessel, if the combined gross tonnage of the vessel and the vessel being towed or pushed is 500 gross tonnage or more; and
- **(c)** vessels that are carrying as cargo a pollutant or dangerous goods, or that are engaged in towing or pushing a vessel that is carrying as cargo a pollutant or dangerous goods.

YEAR INITIATED	YEAR COMPLETED	NAME OF VESSEL	IDENTIFICATION	FLAG	TYPE OF VESSEL	VESSELS CHARACTERISTICS	FULL OR PARTIAL	DIRECTION	ROUTE
2016	**2016**	**Akademik Ioffe**	IMO 8507731	Russia	Passengers ship	117.04m X 18.28m - 7,004 HP - 6,231 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Akademik Ioffe**	IMO 8507731	Russia	Passengers ship	117.04m X 18.28m - 7,004 HP - 6,231 GRT	Partial	West to East	Peel Sound
2016	**2016**	**Akademik Sergey Vavilov**	IMO 8507729	Russia	Passengers ship	117.00m X 18.00m - 3,502 HP - 6,344 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Akademik Sergey Vavilov**	IMO 8507729	Russia	Passengers ship	117.00m X 18.00m - 3,502 HP - 6,344 GRT	Partial	West to East	Bellot Strait
2016	**2016**	**Anna Desgagnés**	IMO 8600507	Canada	General cargo	173.50m X 23.05m - 10,330 HP - 15,893 GRT	Partial	East to West	Peel Sound
2016	**2016**	**Anna Desgagnés**	IMO 8600507	Canada	General cargo	173.50m X 23.05m - 10,330 HP - 15,893 GRT	Partial	West to East	Peel Sound
2016	**2016**	**Bremen**	IMO 8907424	Bahamas	Passengers ship	111.51m X 17.25m - 6,599 HP - 6,752 GRT	Partial	East to West	McClintock Channel
2016	**2016**	**Bremen**	IMO 8907424	Bahamas	Passengers ship	111.51m X 17.25m - 6,599 HP - 6,752 GRT	Partial	West to East	Bellot Strait
2016	**2016**	**Ernest Shakleton**	IMO 9114256	United Kingdom	Icebreaker	80.00m X 17.03m - 7,141 HP - 4,028 GRT	Full	East to West	Bellot Strait
2016	**2016**	**Ernest Shakleton**	IMO 9114256	United Kingdom	Icebreaker	80.00m X 17.03m - 7,141 HP - 4,028 GRT	Full	West to East	Bellot Strait
2016	**2016**	**Havelstern**	IMO 9053218	Canada	Tanker	161.36m X 23.00m - 8,972 HP - 11,426 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Havelstern**	IMO 9053218	Canada	Tanker	161.36m X 23.00m - 8,972 HP - 11,426 GRT	Partial	West to East	Bellot Strait and Fury and Hecla Strait
2016	**2016**	**Mitiq**	IMO 9081308	Canada	General cargo	137.16m X 18.90m - 7,380 HP - 8,448 GRT	Partial	East to West	Peel Sound

2016	**2016**	**Mitiq**	IMO 9081308	Canada	General cargo	137.16m X 18.90m - 7,380 HP - 8,448 GRT	Partial	West to East	Bellot Strait
2016	**2016**	**Ocean Endeavour**	IMO 7625811	Bahamas	Passengers ship	137.10m X 21.40m - 17,280 HP - 12,907 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Ocean Endeavour**	IMO 7625811	Bahamas	Passengers ship	137.10m X 21.40m - 17,280 HP - 12,907 GRT	Partial	West to East	Bellot Strait
2016	**2016**	**Qamutik**	IMO 9081289	Canada	General cargo	136.34m X 19.02m - 7,383 HP - 8,849 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Qamutik**	IMO 9081289	Canada	General cargo	136.34m X 19.02m - 7,383 HP - 8,849 GRT	Partial	West to East	Bellot Strait and Fury and Hecla Strait
2016	**2016**	**Sea Adventurer**	IMO 7391422	Bahamas	Passengers ship	100.01m X 16.24m - 5,280 HP - 4,376 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Sea Adventurer**	IMO 7391422	Bahamas	Passengers ship	100.01m X 16.24m - 5,280 HP - 4,376 GRT	Partial	West to East	Bellot Strait and Fury and Hecla Strait
2016	**2016**	**Travestern**	IMO 9053206	Canada	Tanker	161.36m X 23.00m - 6,000 KW - 9,998 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Travestern**	IMO 9053206	Canada	Tanker	161.36m X 23.00m - 6,000 KW - 9,998 GRT	Partial	West to East	Bellot Strait and Fury and Hecla Strait
2016	**2016**	**Zelada Desgagnés**	IMO 9402082	Canada	General cargo	138.98m X 21.00m - 7,342 P - 9,611 GRT	Partial	East to West	Bellot Strait
2016	**2016**	**Zelada Desgagnés**	IMO 9402082	Canada	General cargo	138.98m X 21.00m - 7,342 P - 9,611 GRT	Partial	West to East	Bellot Strait

There are a number of sea routes which connect the Pacific and Atlantic Oceans, via the Arctic. These include the Northwest Passage and Northeast Passage / Northern Sea Route:

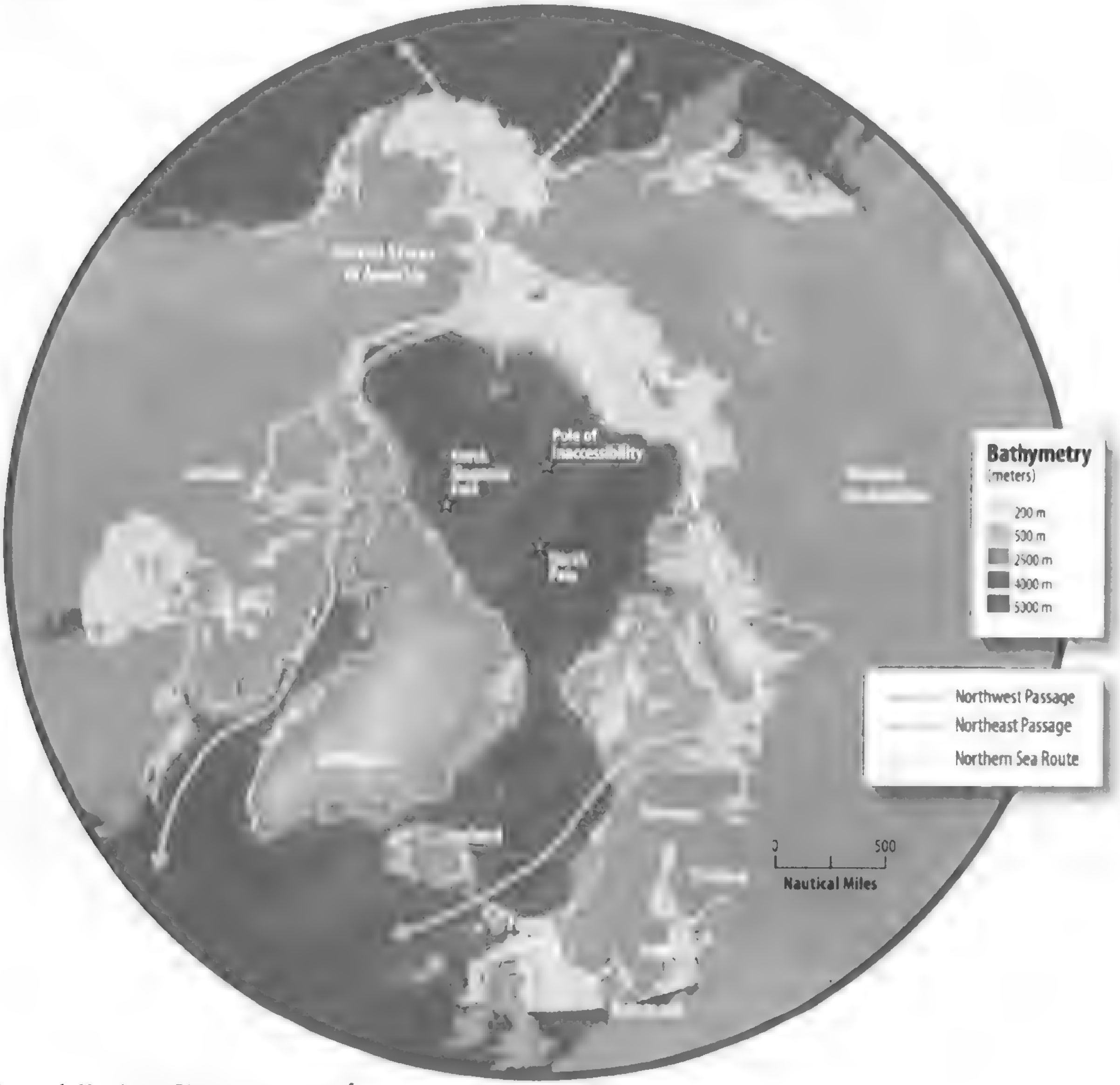


Figure 1. Northern Shipping Routes [4]

[4] Arctic Marine Shipping Assessment 2009 Report. Arctic Council, April 2009, second printing.

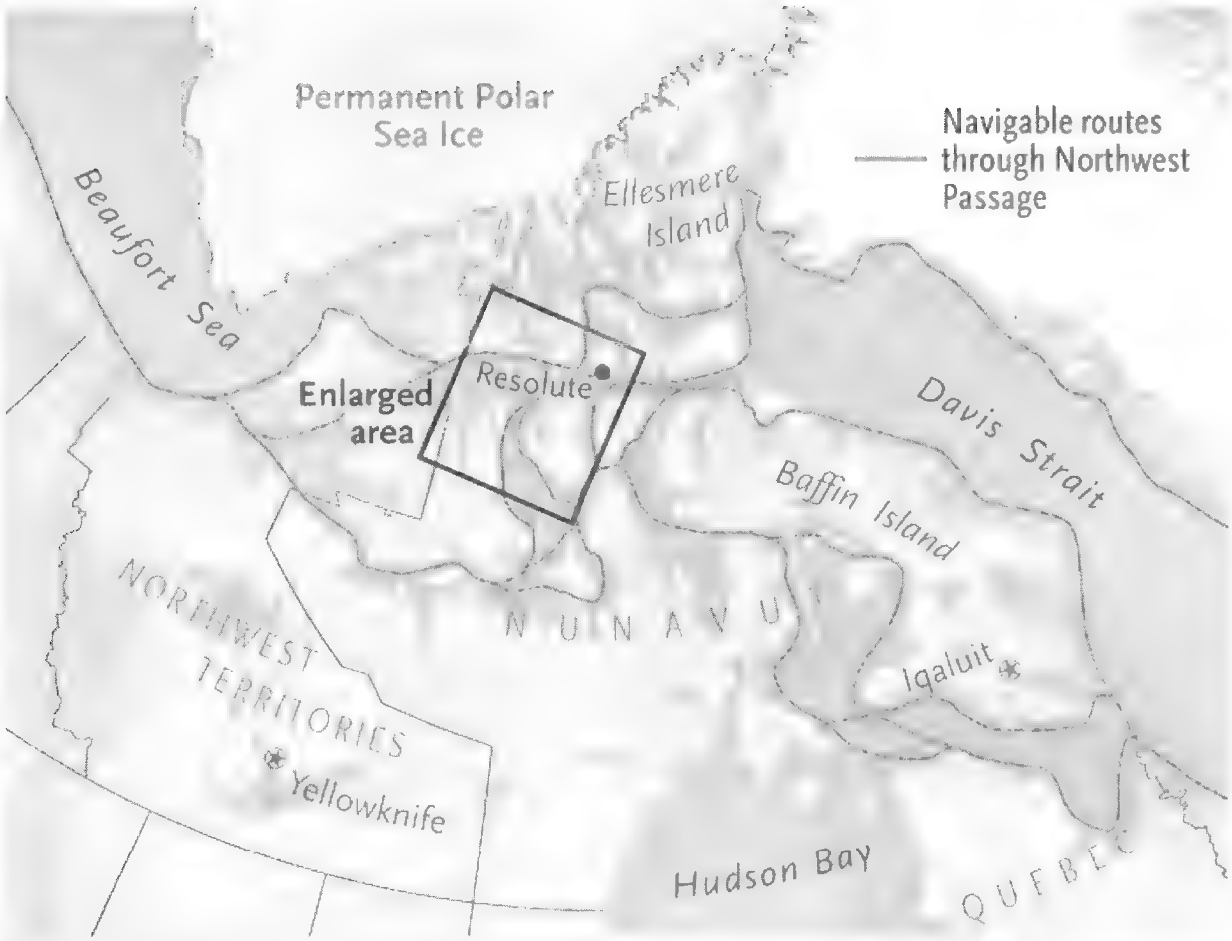


Figure 2. Navigable Routes through the Northwest Passage (Map: Chris Brackley/Canadian Geographic)

- Marine routes and corridors – proposed NMTC project (from Workshop Report)
- Long transit times between ports/facilities by vessels
- Changing operating conditions (ice, wind direction and intensity, sea state, weather events etc.)
- Safety net – regulatory framework, CCG services (icebreaking, ice escort, aids to navigation, marine communications and traffic services, environmental response capability, SAR), weather forecasting, charts, communications networks, vessels of opportunity, etc.
- Northern marine traffic corridors plan
- Shore-based infrastructure
- Local knowledge/situational awareness
- Gaps/risks/issues, e.g. limited charting of coastal waters, high local knowledge but significantly increasing unpredictability (climate change impacts)

F. The Arctic: SAR Picture *(Risk estimation)*

- International framework
- JRCCs
- Other levels of government – territorial and regional government involvement
- CCG Auxiliary Units – Cambridge Bay, etc.

- CASARA

G. Expanding CCG Auxiliary Capacity in the Arctic *(Risk control)*

- Arctic coastal communities with high concentrations of boaters and boats present a significant opportunity for partnerships to build local SAR capacity
- Expanding CCG Auxiliary in Arctic represents an obvious and immediate risk control.
- Developing Auxiliary capacity represents an opportunity to marry the strengths, skills and knowledge of the CCG SAR framework with the strengths, skills and knowledge of the Arctic coastal communities with centuries of local experience in navigating the coastal waters.
- Establishing Auxiliary units would build upon existing local SAR capacity, knowledge, experience and expertise that currently exist in Arctic coastal communities for responding to ground and maritime emergencies. When people are in trouble, these communities rally to do whatever it
- Opportunities to build upon existing synergies between ground SAR and marine SAR with similar skills and expertise brought to bear in SAR situations of any kind.
- Opportunities to build upon historic and cultural linkages across Arctic communities to create establish region-wide networks of SAR capacity and expertise between communities. Such linkages can be established and maintained through activities such as joint training, district level meetings and ongoing communication mechanisms.
- Opportunities for Auxiliary members to boating safety ambassadors – SAR prevention focus.
- Opportunities to improve communications infrastructure
- SAR system – expansion and integration into the SAR system
- Ultimately a regional SAR network

H. Community Engagement *(The Plan)*

- An extensive plan for community engagement was developed and implemented over the 18 month period commencing____ and concluding at the end of March 2017.
- Designing and delivering on the community engagement involved:
    - *Planning*: identifying key contact people in each hamlet office to initiate the plan for the community visits. This included harnessing networks for Senior Administrative Officers and Mayors. A letter sent to each community identified the purpose of the visit and an ideal cross section of people for attendance including members of the Hunter and Trapper Organizations and ground SAR members where such groups existed in the community.
    - *Logistics and scheduling*:
    - *Community visits*:
    - *Taking stock of key findings:*
    - *Planning for follow-ups*

I. Challenges and Opportunities: The Big Picture *(High level perspectives)*

- Opportunities
    - Familiarity with CCG
    - **Cohesive network of Arctic coastal communities** present a significant opportunity for the expansion of the CCG Auxiliary across the Arctic.
    - **Marriage of the CCG Auxiliary model with local capability**, enthusiasm and infrastructure that exists on the ground in the local communities is an ideal match.

- Communities are **well run hamlets**, many with established SAR societies. Among the **community members are skilled boaters** with a depth and breadth of on the water experience, founded on extensive local and traditional knowledge.
- **Communications** with hunters and fishers out on the land or water is a priority for communities. Some communities have erected VHF towers to support communications. In some cases local towers have been funded with regional or territorial government support. This is an area of opportunity on which to build.
- **Empowering/equipping local communities**

- Challenges
  - Climate change, environmental changes and changing weather patterns have increased risks in the maritime environment at the local level
  - Changing ice conditions
  - Wind patterns are more unpredictable in terms of both direction and intensity
  - With changing winds, coves and inlets that may have provided safe havens for centuries past may no longer afford protection to wait out bad weather
  - Patterns of boating changing in line changes to hunting and fishing grounds, longer distances travelled
  - At the region-wide level, resource growth in the north means increased transient vessel traffic and maritime growth as a whole is increasing.

J. On the Ground: Community Engagement *(Implementing the plan)*

- Planning
  - Stark contrast from working in the south – logistics, travel , weather
  - Laying the ground, first contact, a lot of work
  - Range of inter-related contacts – Mayors, Senior Administrative Officers, Community Economic Development Officers, Clerks, SAR Societies, Hunting and Trappers Organizations (HTO), Territorial and regional official
  - Two to three visits per day via chartered aircraft
  - Critical success factor – getting the right people, gear, room, scheduling
- Community visits – the ground covered
  - Each community visit took the form of meeting of one and a half to two hours involving a joint presentation of the CCG and CCG Auxiliary and an interactive discussion to learn about the community. Meetings were for the most part well attended with a wide cross section of community members.
  - The presentation and ensuing discussions were designed to promote an understanding of the CCG services and programs, the SAR framework for the Arctic, the specific objectives of the review of Arctic SAR and the community benefits of establishing an Auxiliary unit.
  - In each and every community there was a high level of interest in the CCG SAR Arctic review and the potential for the establishment of CCG Auxiliary unit or other efforts to support SAR readiness.
  - With each visit, an increasingly comprehensive picture was developed of the dimensions of boating activity across the Arctic and changing risk factors. The significant opportunity for expanding CCG Auxiliary capacity drawing on the experience, skills and knowledge of coastal community members was increasingly reinforced with each community visit.

- Taking stock of key findings

- Community interest very high
- The visits created a much improved understanding of life in the Arctic and the importance of and marine-related activities for sustenance and survival. Boating is an integral part of life for hunting, fishing, whaling and leisure activities. In many instances long distances are travelled to hunting grounds and for fishing and whaling activities.
- A wide range of boats exist from freighter canoes to Silver Dolphins. In some communities there are as many as 100 boats for a population of 300 people.
- Challenges exist in terms of availability of safety equipment. There were mixed awareness of the mandatory equipment requirements of the *Small Vessel Regulations*. Challenges of obtaining safety equipment were identified across several communities.

- Special considerations
  - Some communities ready to go, others will take more time – phased approach
  - ER role raised often
  - Language of materials
  - Important to harness HTO, SAR societies and elders/community leaders
  - Build on intergenerational strengths

- Post visit follow-ups
  - Build on RAMSARD assessment with follow-up survey for more detailed evaluation and consistent information community to community; this survey will serve to build on community engagement and relationship-building

K. Enlightenment: New Awareness of Life in the Arctic

- Special awareness of life in Arctic – ice, distance, climate, communications and VHF, boat mix
- Boating activities are diverse, associated with a range of activities – fishing, whaling, sealing and travel to hunting grounds and camps. Long distances are travelled in many cases. Boating is also part of social and cultural activities, including day trips to adjacent islands or camps along the coast.
- **Risk factors are higher than expected** and growing. Increasing risks associated with boating activities
  - Changing and unpredictable weather patterns
  - Changing sea conditions
  - Changing wind patterns
  - Extended length of boating seasons
  - Extreme weather events
- Significant opportunity to develop local SAR capacity through establishment and development of CCGA units.
- Most communities visited had established local SAR capacity in some form, for both ground and marine SAR. In many communities, members of HTOs formed the foundation for local SAR societies.
- Boaters are knowledgeable and skilled, with extensive on the water experience.
- Boating safety awareness is high with attention paid to trip planning and informing friends or relatives ashore of planned travel on the water.
- Equipment availability issues – some communities have loaner programs for PFDs, sat phones, floater suits.

- Inconsistencies in awareness of *Small Vessel Regulations* equipment carriage requirements. Also inconsistent awareness of operator competency regulations. No Transport Canada relationship evident.
- Wide range of boats
- Positive impression of CCG (though icebreakers and broken ices can have risk impacts on ice conditions for local boating activities.
- Communications challenges are pervasive with keen interest in solutions.
- Respect for traditional languages.
- Infrastructure exists, in some cases more is required– docks, wharves, breakwaters, walls, boat ramps.
- Intergenerational involvement important – elders, youth, community leaders.
- Ground SAR societies are for the most part strong and well organized.

L. Standing up CCG Auxiliary Units: The Process *(Risk control in action)*

- Attention was paid in community visits to educating and informing on process of establishing community units to ensure that communities understood both opportunities and benefits as the expectations and obligations associated with becoming Auxiliary members and forming community level Auxiliary units.
- Particular attention was paid to discussing with community members how the establishment of Auxiliary units would harness and align with the capacity, skills, experience and expertise currently existing in the community.

The community visits afforded an opportunity to assess following:

- Marine risks factors and SAR demands being faced by the community
- The right boats – the extent to which suitable boats existed in the community to serve as Auxiliary boats
- The right people – community members with the interest and boating skills and knowledge to become Auxiliary members; community members that could serve as Auxiliary unit leaders and community members that could support the logistical and administrative infrastructure critical to successful Auxiliary units
- Community support and capacity, in terms of for example hamlet support.

- Post community visit, these factors were assessed to land upon a determination of first of the appropriateness of establishing an Auxiliary unit, or alternatively considering alternative approaches to enhancing SAR prevention and boating safety in the community.
- Second, communities were assessed from the perspective of readiness to stand up an Auxiliary unit. It was determined that a phased approach to standing up units and that those units coming on board early could serve to support other communities in working toward readiness to become Auxiliary units in the future.

M. Standing Up CCG Auxiliary Units: Unique Challenges *(additional risk identification, estimation and evaluation)*

- Ambitious goal to establishing several units across the Arctic over a short time frame
- Challenges for planning and implementation in identifying and evaluating boats, equipping boats, recruitment of leaders and members, training.
- High costs of travel – needs to be planned carefully to maximize cost effectiveness.

- Short on water training session to get Units to operational status quickly. (Some classroom training already delivered ahead of coming season)
- Language and cultural sensitivity considerations.

N. Opportunities and Solutions *(further risk controls)*

- Synergies at many levels to be harnessed
  - SAR systems and hamlet
  - Hamlet to hamlet (Arctic SAR network)
  - Government of NWT/Government of Nunavut/Kativit Regional Government and hamlet, CCG Auxiliary, CCG
- Communication improvements will mitigate risks
- CCG Auxiliary Unit members can be local boating safety ambassadors – further risk reduction, and influencing next generation of boaters (partner to Transport Canada)
- JRCC SAR systems will further enhances SAR – hamlet synergies
- Hamlet to hamlet connections – a SAR culture across the Arctic
- Hamlet, territorial ,regional government, GN MOU and funding
- Connecting with local capacity – Nunavut fisher school

Additional meetings will be required with existing Search and Rescue partners namely the RCMP to review and update current MOU that exist between the RCMP, CCG and CCGA. Existing documentation may be needed to meet the need of not only the Western Arctic but also the Eastern. Currently the document only covers 5 Arctic units that utilize RCMP vessels for Search and Rescue missions.

O. Strategic considerations

- Marine environment/marine safety of significant importance to northern residents
- Special features of the Arctic are so significant, a tailored strategy will be important to harness opportunities and overcome challenges – innovative, creative approaches with appropriate oversight and risk mitigation – strategic management and oversight of the full project will be important
- Many opportunities to link up with other CCG, DFO, Other Government Department priorities and initiatives – these need to be fully indentified explored
- CCG linkages include – planned engagement for environmental response, development of Northern Marine Protected Corridors
- DFO linkages include – Marine Protected Areas, fisheries development (potential for new northern fisheries), infrastructure (at least one community in dire need of breakwater in light of climate change impacts, notably reduced shore ice exposing hamlet shoreline and launch point for boats to rough waters)
- Community relationships could be harnessed for
- Connection to Government of Canada priorities – northern development, climate change, Truth and Reconciliation, youth engagement, Parks Canada
- Clarity is required on Transport Canada plans for Arctic engagement, future of National SAR Secretariat, RCMP role (inconsistent level of involvement across Canada and across Arctic) and other players – these represent additional risk mitigation considerations
- Partnership potential with other levels of government and clarity of roles with territorial and regional government
- Partnership potential with safety equipment manufacturers

P. Moving Forward: Action Monitoring

- Financial monitoring and sustainability
- Watch inflation
- Cost of running a separate Arctic Region
- Ultimate goal – SAR in every hamlet

Policy= Arctic/GGC/Inuit relations and operations = strong management

Emerging partnerships

- Formal MOR with local government and GN – engaging of territorial government
- Paying for SVR gears
- (CCGA paying for SAR gear)
- Support to SAR society in hamlet
- Parks Canada
- Leveraging and harnessing
- Intradepartmental linkages and external engagement will continue to be a priority.

Planning for Arctic Region -expansion of units North of 60 and the possibility of the development of a new CCGA Arctic Region we will have to look developing a new regional specific set of By-laws for the North.

Northern Cree, Labrador Inuit, MCTS expansion, VHF service

ER/Aux role

Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Coast Guard | Garde côtière canadienne

UNCLASSIFIED

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BRIEFING NOTE TO THE ASSISTANT COMMISSIONER

INITIAL RISK-BASED ANALYSIS OF MARITIME SEARCH AND RESCUE DELIVERY – ARCTIC REGION (2017)

(FOR INFORMATION)

SUMMARY

The purpose of this note is to present a regional SAR risk profile of four areas of the Arctic: Northwest Territories, Western Nunavut, Eastern Nunavut, and Nunavik. These risk profiles were generated through the provision and analysis of supporting data for Search and Rescue activity and ice conditions during the operational season for these areas.

Additional information captured during the Arctic SAR study, completed from 2015-2017 was incorporated where possible.

This information should be used to guide further investment in the Arctic, for both CCG infrastructure (i.e., Inshore Rescue Boat stations) as well as activities where CCG undertakes an advisory role (i.e., CCGA expansion activities).

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BACKGROUND: MARTIME SAR RISK PROFILE GENERATION

This report references historical SAR incident data from SISAR, which was used to generate a profile of maritime SAR risk for a specific area under review. This profile was developed relying not only on the data itself, but on the experience and knowledge of the Analysis Team.

Incidents classified based on type and level of severity
M - Maritime Incidents (M1, M2, M3, M4)
A – Aeronautical Incidents (A1, A2, A3, A4)
H – Humanitarian Incidents (H1, H2, H3, H4)
U – Unknown Incidents (U4)
1 - Distress incidents:
A vessel or a person is threatened by grave and imminent danger and requires immediate assistance. (Life-threatening situation was judged to be present or close at hand at some point during the incident);
2 - Potential Distress incidents:
The potential exists for a distress incident if timely action is not taken; i.e., immediate responses are required to stabilize a situation in order to prevent distress;
3 - Incidents resolved in the uncertainty phase (Non-Distress):
No distress or perceived appreciable risk to life apparent. (General calls for assistance);
4 - False alarms and hoaxes:
Situations that cause the SAR system to react which proves to be unjustified or fabricated, such as a mistaken report of a flare.

The profiles generated in this report focused primarily on maritime distress and potential distress (M1 and M2) cases. (M3 and M4) cases were considered in the overall statistics, but will be distinguished from M1, M2 cases in the depiction of all maritime SAR cases in the Area to the greatest extent possible.

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1. NORTHWEST TERRITORIES

Summary: Since 2007, there have been 32 marine SAR cases in the Northwest Territories region, which also includes the waters of the Coronation Gulf south of Victoria Island through the Jamieson Islands. There have also been 25 Aeronautical SAR cases in this time period; however, the majority have occurred in inland regions, but are still captured within the dataset.

An examination of the marine SAR cases in the region demonstrates that the majority of the cases are less-severe (M3/M4), and the M2 cases have varying actions taken, based on the table below:

Year	Incident Number	Final Classification	Incident Type	Craft Category	Craft Sub-Category	Craft Type	Action Taken
2016	C2016-1452	**M2**	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Other
2012	C2012-1928	**M2**	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
2011	C2011-1818	**M2**	Other	**Pleasure**	Pleasure	**Motor Craft**	Search
2010	C2010-2484	**M2**	Medical	**Pleasure**	Marine Transportation	**Motor Craft**	Evacuation
	C2010-2274	**M2**	Grounded	**Commercial**	Marine Transportation	**Cruise Ship**	Rescue
	C2010-2561	**M2**	Medical	**Commercial**	Marine Transportation	**Tug**	First Aid
2008	C2008-1865	**M2**	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Evacuation
	C2008-2171	**M2**	Medical	**Government**	Marine Transportation	**Government Vessel**	Investigation

Examining the risk assessment heat map for the region, the RAMSARD risk assessment for the region is generally low, with some medium risks attributed to inland aircraft SAR cases. Additional areas of concern remain should be extended to commercial vessels, as per the blue highlights in the table above.

Impact		Rare	Unlikely	Moderate	Likely	Almost Certain
	Extreme					
	High		Commercial Vessel (M2) Large Aircraft (A1)			
	Moderate					
	Low		Pleasure Craft (M1, M2) Small Aircraft (A1)	Pleasure Craft (M3)		
	Negligible					
		Likelihood				

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Location-Specific SAR Statistical Support

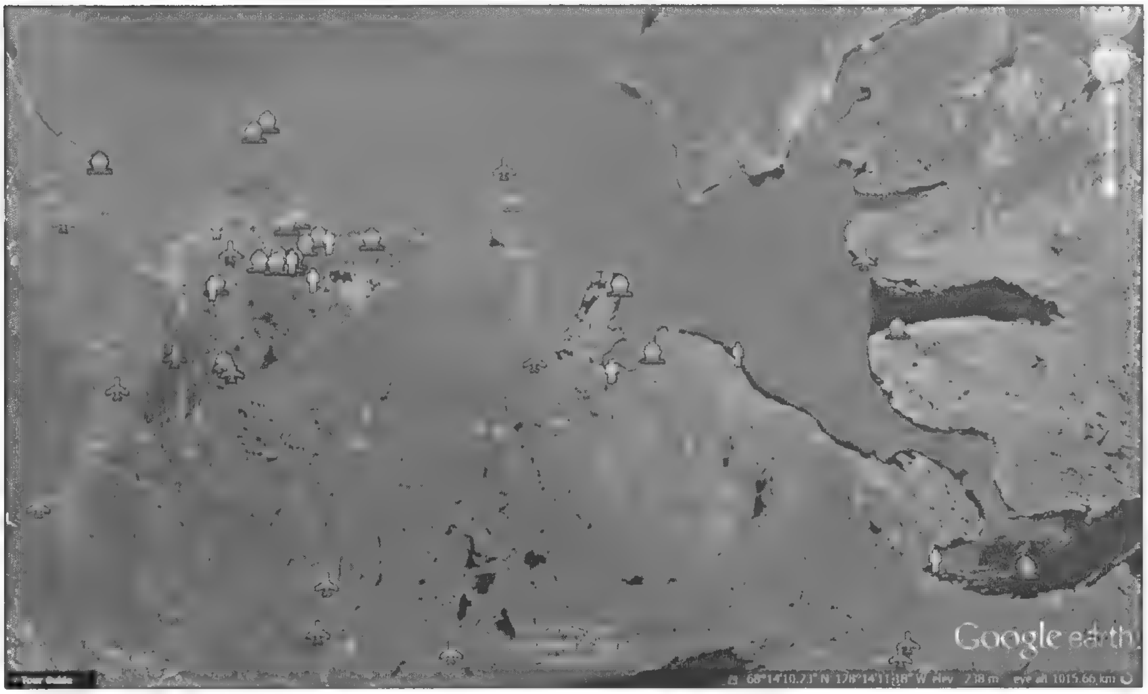

Figure 1. Map of SAR Cases 2007-2016.

As you can see from the above image depicting SAR cases from 2007-2016, much of the maritime SAR activity has been concentrated in the area of Tuktoyaktuk and the Mackenzie Delta. Local marine SAR response in the Territory consists of five Canadian Coast Guard Auxiliary units (Inuvik, Aklavik, Ulukhaktok, Paulatuk and Tuktoyaktuk) which operate under a Memorandum of Understanding with the RCMP. The existing units in Inuvik, Aklavik and Tuktoyaktuk are within range to respond to incidents within the highlighted area.

The following map illustrates existing SAR response range of assets within the area, which is comprised of these CCGA units:

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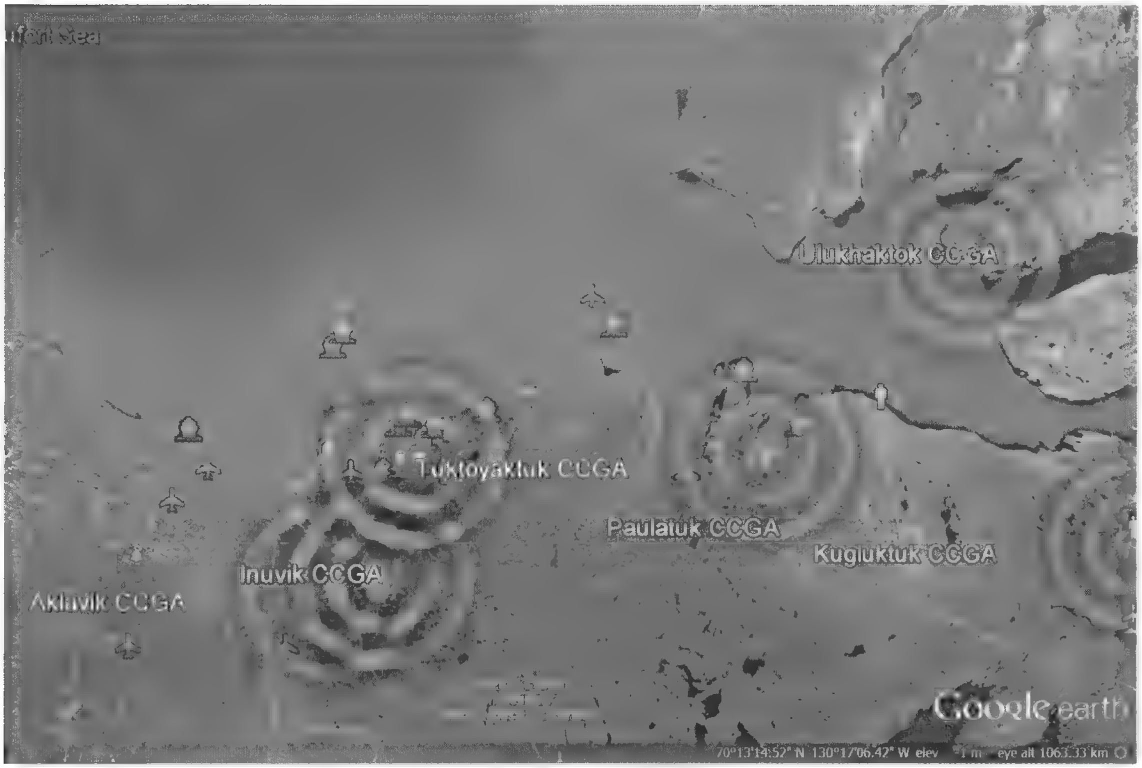

Figure 2. Map of CCGA units in Northwest Territories.

Examining the SAR case profile and response capacity for the Northwest Territories, there are relatively few SAR cases within are not within the response range for an existing CCGA unit. As such, it is recommended that continued investment and training and exercising of these units be carried out to ensure they remain in an operational state.

Ice Conditions

However, the ice conditions in this area are more severe than in other areas of the Arctic, but relatively consistent in nature. The following images[1] illustrate the ice conditions for successive years at the beginning of summer – July 1, 2014 and July 1, 2015.

[1] **Disclaimer:** The USNIC Daily Ice Edge product depicts the daily sea ice pack in red (8-10/10ths or greater of sea ice), and the Marginal Ice Zone (MIZ) in yellow. The marginal ice zone is the transition between the open ocean (ice free) and pack ice. The MIZ is very dynamic and affects the air-ocean heat transport, as well as being a significant factor in navigational safety. The daily ice edge is analyzed by sea ice experts using multiple sources of near real time satellite data, derived satellite products, buoy data, weather, and analyst interpretation of current sea ice conditions. The product is a current depiction of the location of the ice edge vice a satellite derived ice edge product.

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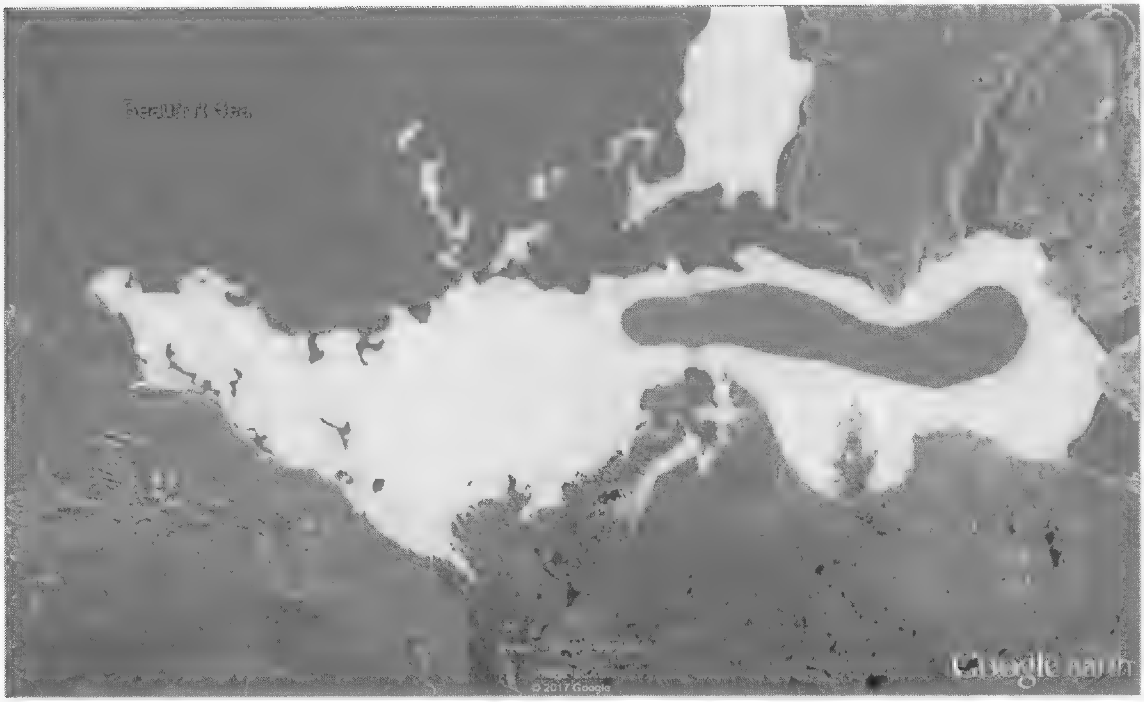

Figure 3. Ice Conditions on July 1, 2014

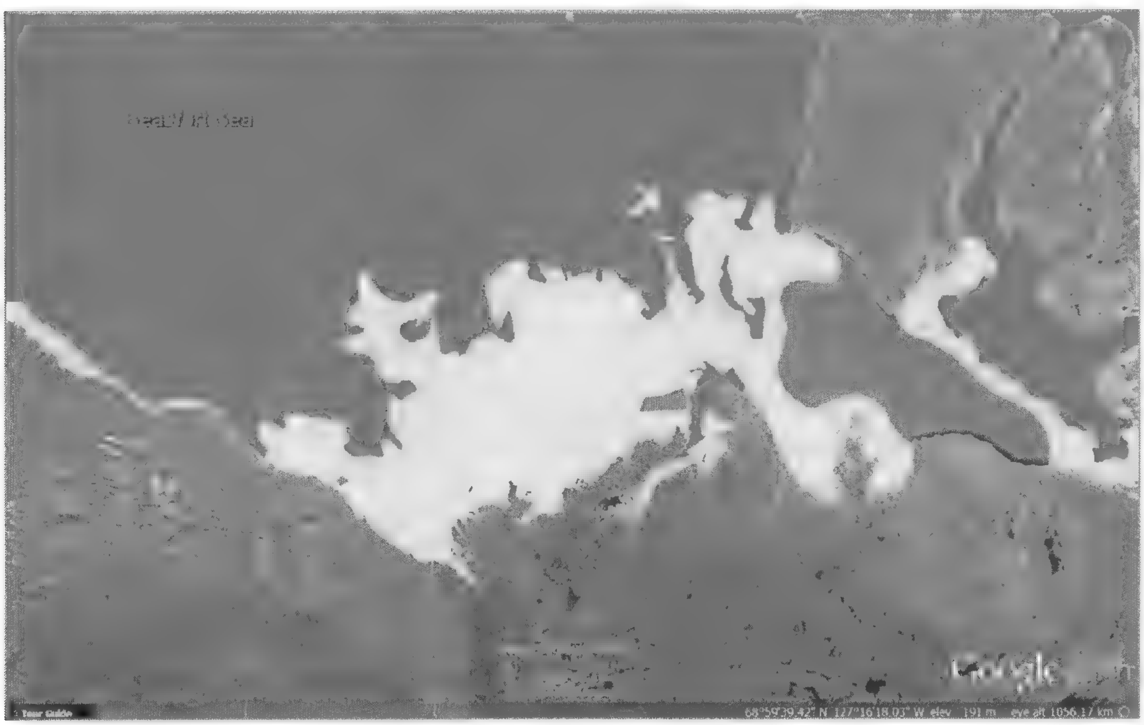

Figure 4. Ice Conditions on July 1, 2015

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Similarly, at the end of the operational season, this area has the potential for early sea ice formation and encroachment from the Beaufort Sea, as evidenced by the following images, depicting ice conditions on September 15, 2014 and September 15, 2015.

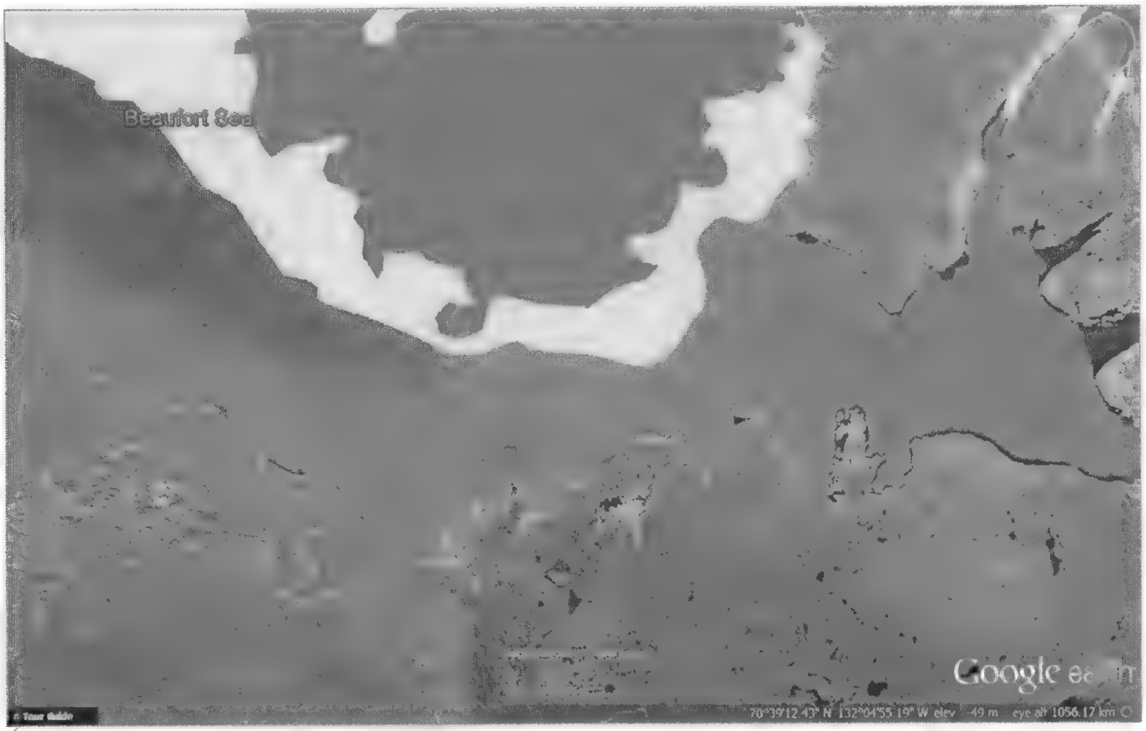

Figure 5. Ice Conditions on September 15, 2014

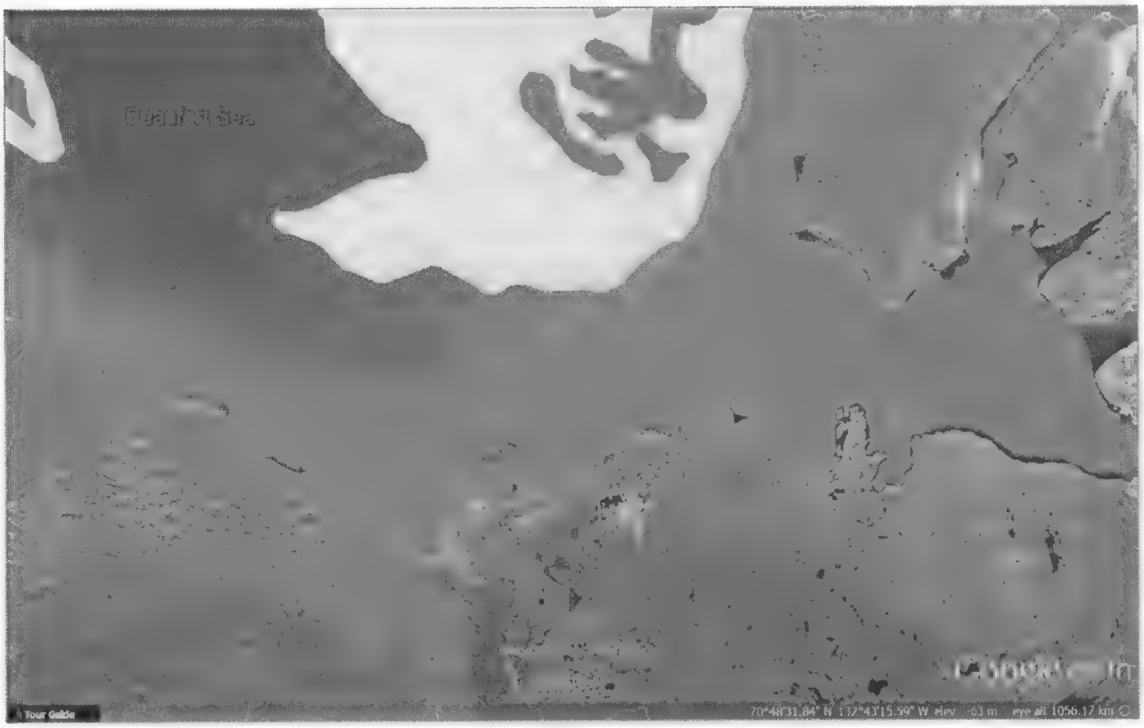

Figure 6. Ice Conditions on September 15, 2015

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Comprehensive SAR Risk Estimation

Impact						
	Extreme					
	High		10,12,25	24		
	Moderate			20		
	Low		1,2,17,25,26,27,28	1		
	Negligible					
		Rare	Unlikely	Moderate	Likely	Almost Certain
		Likelihood				

Note: The RAMSARD process is not a relative risk tool, and should not be used to compare area risks to other area risks or to the national risk matrix. Each area has unique risks and may have unique resources to cover those risks. During consultations with stakeholders, the national risk matrix will be shown only to indicate that it is complete and to show that local figures are used in the Analysis (as opposed to the national figures being applied to local area assessments).

CATEGORY			
1	M1 - Pleasure Craft	**15**	M3 - Major Ferry - Oil Rig
2	M2 - Pleasure Craft	**16**	M4 -Major Ferry - Oil Rig
3	M3 - Pleasure Craft	**17**	A1 - Small Aircraft
4	M4 - Pleasure Craft	**18**	A2 - Small Aircraft
5	M1 - Fishing Vessel	**19**	A3 - Small Aircraft
6	M2 - Fishing Vessel	**20**	A4 - Small Aircraft
7	M3 - Fishing Vessel	**21**	A1 - Large Aircraft
8	M4 - Fishing Vessel	**22**	A2 - Large Aircraft
9	M1 - Commercial Vessel	**23**	A3 - Large Aircraft
10	M2 - Commercial Vessel	**24**	A4 - Large Aircraft
11	M3 - Commercial Vessel	**25**	H1 - Humanitarian
12	M4 - Commercial Vessel	**26**	H2 - Humanitarian
13	M1 - Major Ferry - Oil Rig	**27**	H3 - Humanitarian
14	M2 - Major Ferry - Oil Rig	**28**	H4 - Humanitarian

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This Risk Assessment is based on the parameters:

Table 1 – Impact

Impact	
Extreme	More than 50 lives lost in incident.
High	More than 10 lives lost in incident.
Moderate	More than 5 lives lost in incident.
Low	One to five lives lost in incident.
Negligible	No lives lost in incident.

If the data is absent, all reviewers will be required to use the following assumptions for determining consequences:

- A pleasure craft has four persons on board;
- A fishing vessel has five persons on board;
- A commercial vessel has twenty persons on board;
- A cruise ship, ferry or oil rig has more than fifty persons on board;
- A small aircraft carries ten or fewer persons; and
- A large aircraft carries more than ten persons.

Table 2 – Likelihood

Likelihood	
Almost Certain	1 incident or more per week
Likely	1 or more incident per month
Moderate	1 or more incident per year
Unlikely	1 incident every 10 years
Rare	1 incident every 25 years or more

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ANNEX: Northwest Territories Expanded Regional SAR Case Profile: 2007 – 2016.

Air – 25; Marine – 32; Humanitarian – 14

Year	Final Classification	Incident Type	Craft Category	Craft Sub-Category	Craft Type	Action Taken
2016	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	A4	Other	Other	Unknown	Other	Investigation
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	H3	Medical	Other	None/Not Applicable	Evacuation	Rescue
	M2	Disabled	Pleasure	Pleasure	Motor Craft	Other
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Other
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	H3	Missing Person(s)	Other	None/Not Applicable	Missing Person	Search
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
2015	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	M4	False Alarm	Other	None/Not Applicable	Nil	Search
	M3	Other	Pleasure	Hunting	Motor Craft	Search
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	M4	Medical	Commercial	Marine Transportation	Cruise Ship	Communicatio n
	M3	Disabled	Pleasure	Hunting	Motor Craft	Towed
	M5	Other	(blank)	(blank)	(blank)	Communicatio n
2014	H2	Missing Person(s)	Other	None/Not Applicable	Missing Person	Search
	M1P	Disoriented	Pleasure	Pleasure	Kayak	None
	M3	Grounded	Pleasure	Pleasure	Motor Craft	Refloated
	A5	Other	(blank)	(blank)	(blank)	None
	M5	Other	Commercial	Marine Transportation	Tanker	Investigation
	H4	Missing Person(s)	Other	None/Not Applicable	Missing Person	Other
	H4	False Alarm	Other	None/Not Applicable	PLB Search	Investigation
	A4	False Alarm	Air	Air (Commercial)	Single Engine Aircraft	Investigation
2013	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	A5	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation

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	A4	False Alarm	Air	Air (Government/ Military)	Multi-Engine Aircraft	Investigation
	M3	Stranded	Pleasure	Unknown	Motor Craft	Monitoring
	A4	False Alarm	Air	Air (Private/Pleasu re)	Single Engine Aircraft	Investigation
	A4	Forced Landing	Air	Air (Commercial)	Single Engine Aircraft	Investigation
2012	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	A4	Other	Air	Air (Commercial)	Helicopter	Investigation
	A1P	Crash	Air	Air (Government/ Military)	Multi-Engine Aircraft	Monitoring
	M1	Other	Pleasure	Hunting	Motor Craft	Search
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	M2	Stranded	Pleasure	Pleasure	Motor Craft	Evacuation
	M4	Other	Commercial	Marine Transportation	Tug	Communicatio n
2011	A5	Other	Other	Unknown	Other	Investigation
	H5	Other	Other	None/Not Applicable	PLB Search	Investigation
	H2	Medical	Other	None/Not Applicable	Medevac	Communicatio n
	A1P	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	None
	M3	Other	Pleasure	Pleasure	Motor Craft	Communicatio n
	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	M2	Other	Pleasure	Pleasure	Motor Craft	Search
2010	H2	Stranded	Other	None/Not Applicable	Evacuation	Rescue
	M3	Other	Pleasure	Hunting	Motor Craft	Investigation
	H4	False Alarm	Other	None/Not Applicable	Assist Police	Investigation
	A4	Airborne Emergency	Air	Air (Commercial)	Helicopter	Investigation
	M2	Medical	Pleasure	Marine Transportation	Motor Craft	Evacuation
	M5	Other	(blank)	(blank)	(blank)	Communicatio n
	A5	False Alarm	(blank)	(blank)	(blank)	Other
	M2	Grounded	Commercial	Marine Transportation	Cruise Ship	Rescue
	M2	Medical	Commercial	Marine Transportation	Tug	First Aid
	M4	False Alarm	Commercial	None/Not Applicable	Oil Rig	Communicatio n

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	H2	Missing Person(s)	Other	None/Not Applicable	Other	Search
2009	A2	Crash	Air	Air (Commercial)	Single Engine Aircraft	Rescue
	M4	False Alarm	Pleasure	Pleasure	Open Boat	Search
	M5	Other	(blank)	(blank)	(blank)	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Other	Unknown	Other	Investigation
	U4	Other	Air	Unknown	Multi-Engine Aircraft	Investigation
	M4	False Alarm	Commercial	Marine Transportation	Tug	Investigation
	U4	Other	Other	Unknown	Unknown	Investigation
	A5	On Fire	(blank)	(blank)	(blank)	Investigation
	A5	Other	(blank)	(blank)	(blank)	Monitoring
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	H3	Missing Person(s)	Other	None/Not Applicable	Missing Person	Search
2008	M4	Other	Other	Unknown	Unknown	Investigation
	A4	False Alarm	Other	Unknown	Unknown	Investigation
	A4	Other	Air	Air (Commercial)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	M4	False Alarm	Other	Unknown	Unknown	Communication
	A5	Other	(blank)	(blank)	(blank)	Investigation
	H1	Other	Pleasure	Hunting	Open Boat	Search
	H5	Other	(blank)	(blank)	(blank)	Monitoring
	M2	Medical	Commercial	Marine Transportation	Cargo Ship	Evacuation
	M4	False Alarm	Pleasure	Pleasure	Motor Craft	Investigation
	M4	False Alarm	Commercial	Unknown	Tug	Investigation
	M2	Medical	Government	Marine Transportation	Government Vessel	Investigation
	A1P	Crash	Air	Air (Commercial)	Helicopter	None
	M3	Disabled	Fishing	Pleasure	Fishing Vessel	Refloated
	H3	Other	Pleasure	Unknown	Motor Craft	Monitoring
	H3	Missing Person(s)	Other	Hunting	Person	Communication
	A5	Other	Other	Unknown	Unknown	Investigation
	U4	False Alarm	Other	Unknown	Unknown	Monitoring
	A5	Other	(blank)	(blank)	(blank)	Monitoring
	A4	False Alarm	Air	Air	Single Engine	Search

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				(Commercial)	Aircraft	
	A1	Crash	Air	Air (Commercial)	Helicopter	Investigation
2007	**A5**	Other	(blank)	(blank)	(blank)	Communication
	A5	Other	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation

2. WESTERN NUNAVUT / HUDSON BAY

Summary: Since 2006, there have been 137 marine SAR cases in the Western Nunavut region, which also includes the waters of the Coronation Gulf south of Victoria Island through the Jamieson Islands. There have also been 205 Aeronautical SAR cases in this time period; with many cases occurring in inland regions, relatively few on or near Arctic waters. The number of aeronautical SAR cases is skewed due to 140 A4/A5 cases occurring during this time period, which are considered false alarms, and are not included in the image below.

Examining the risk assessment heat map for the region, the maritime RAMSARD risk assessment for the pleasure crafts in the region is generally low, with some medium risks attributed to inland aircraft SAR cases and commercial vessels.

Impact		Rare	Unlikely	Moderate	Likely	Almost Certain
	Extreme					
	High		Commercial Vessel (M1-M4) Large Aircraft (A2-A3)	Large Aircraft (A1, A4)		
	Moderate					
	Low		Pleasure Craft (M1)	Pleasure Craft (M2-M4)		
	Negligible					
		Likelihood				

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Location-Specific SAR Statistical Support

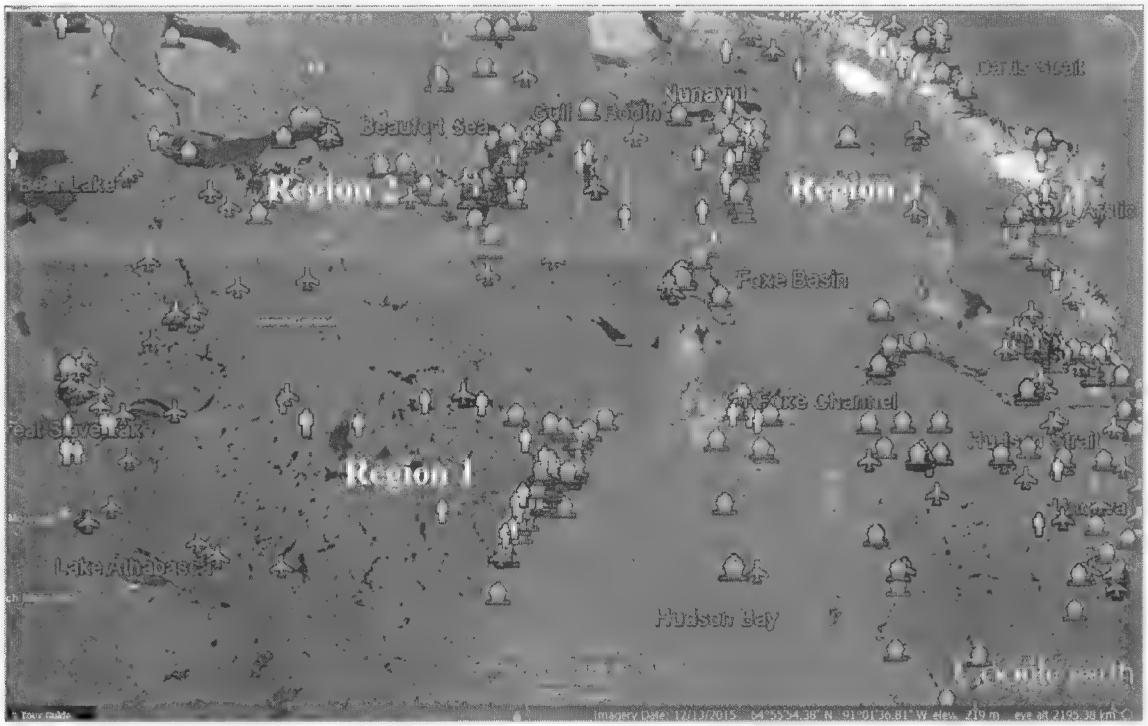

Figure 7. Map of SAR Cases 2006-2016.

Within this region, it is apparent that there are several clusters of historical SAR cases: (1) Western Hudson Bay – Arviat to Chesterfield Inlet; (2) the area around King William Island; (3) Northwestern section of Foxe Basin (Igloolik area). These areas are highlighted in the overview map.

Focusing on these three areas, there is SAR response capacity through existing CCGA units in Rankin Inlet and Gjoa Haven. The following map illustrates existing SAR response range of assets within the area, which is comprised of these CCGA units:

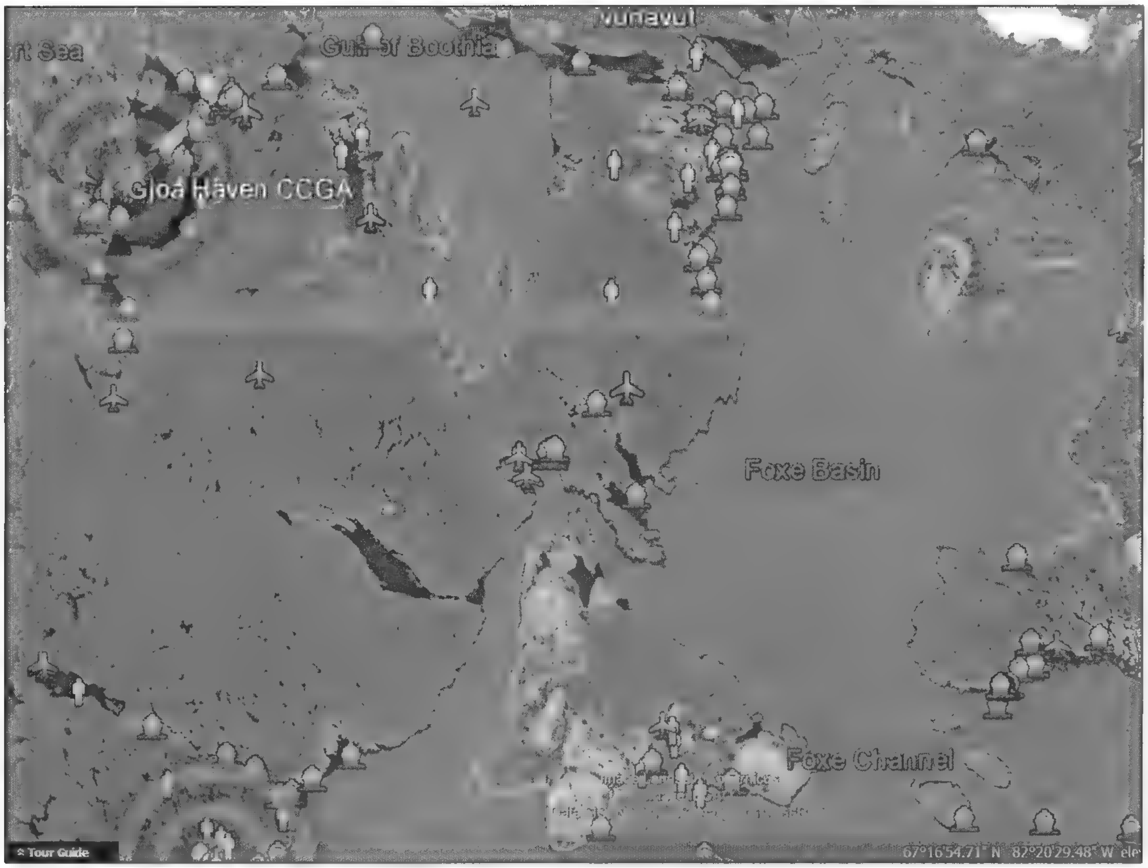

Figure 8. Existing CCGA units in Western Nunavut Region for the areas of interest.

The figure below identifies the response range of CCGA units currently being established (i.e., not online and fully trained). Once online, these units will provide a formalized response capacity in some of the areas identified. As of August 2017, the following communities have CCGA units who are in the process of formation: Hall Beach, Igloolik and Taloyoak.

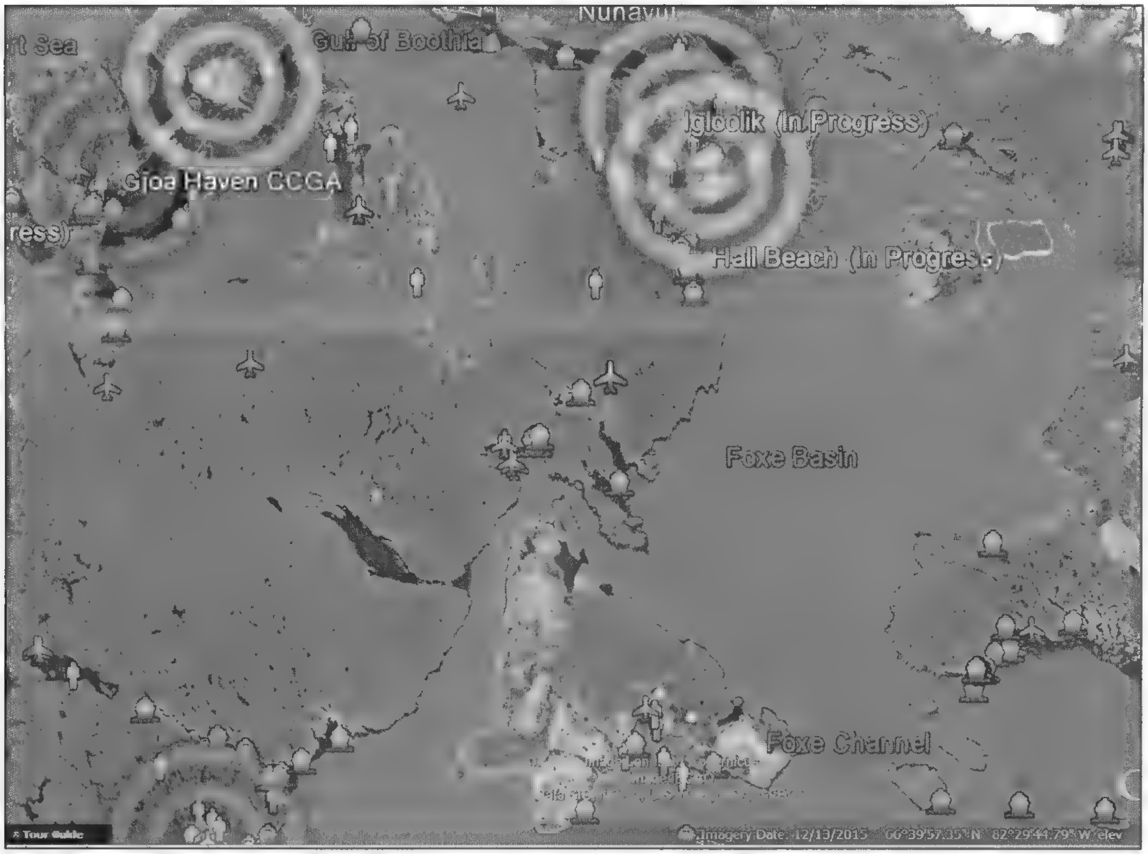

Figure 9. Existing and 'In Progress' CCGA units in Western Nunavut Region for the areas of interest.

Ice Conditions

Examining the historical ice conditions, it appears that the ice conditions in the region vary considerably due to geography. Extended icing conditions are prevalent in the more northern portions of the region, while longer ice-free conditions exist in more southerly locations.

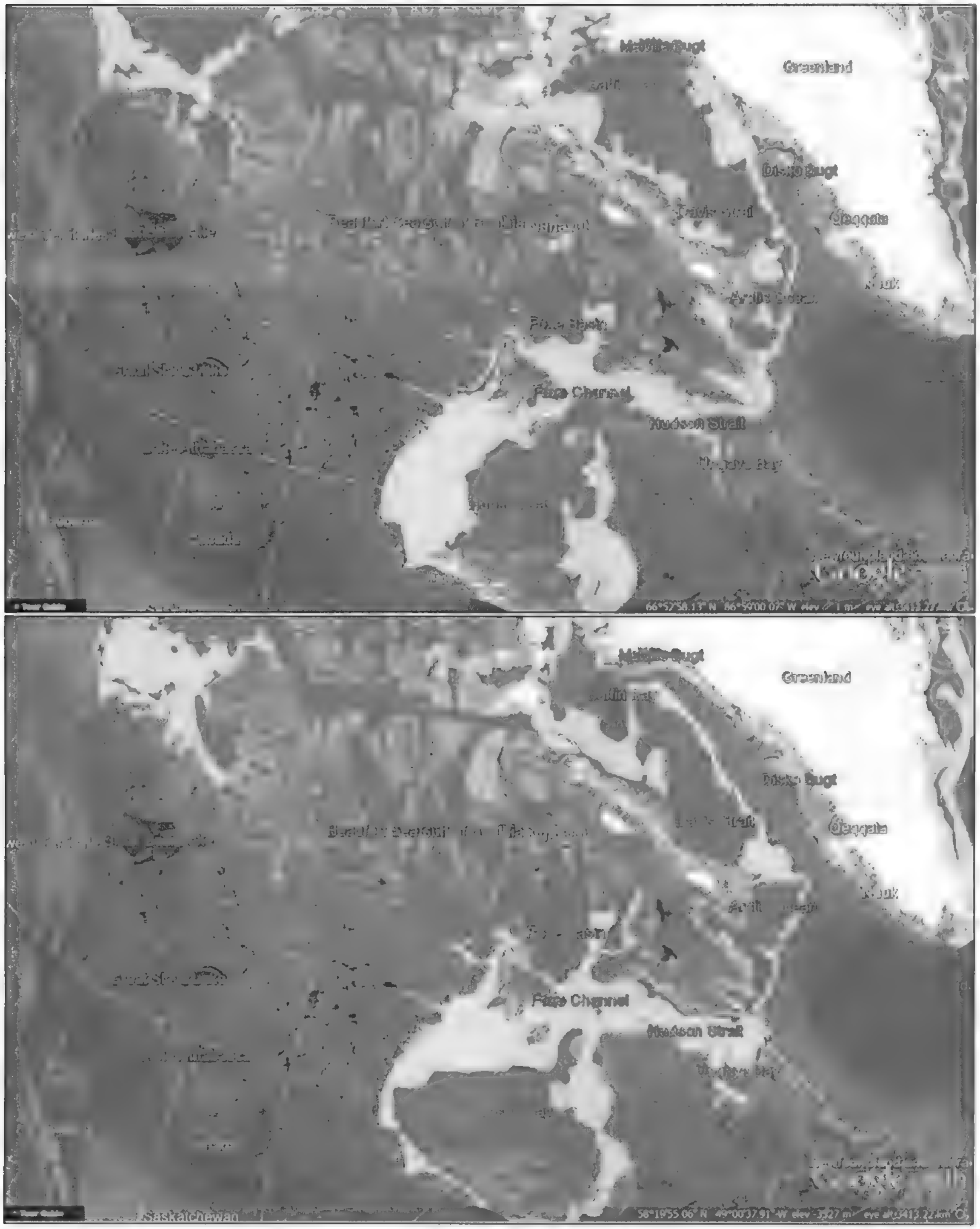

Figure 10. Representation of the more severe ice conditions seen at the beginning of the season, as seen on July 1, 2011 (top) and July 1, 2012 (bottom).

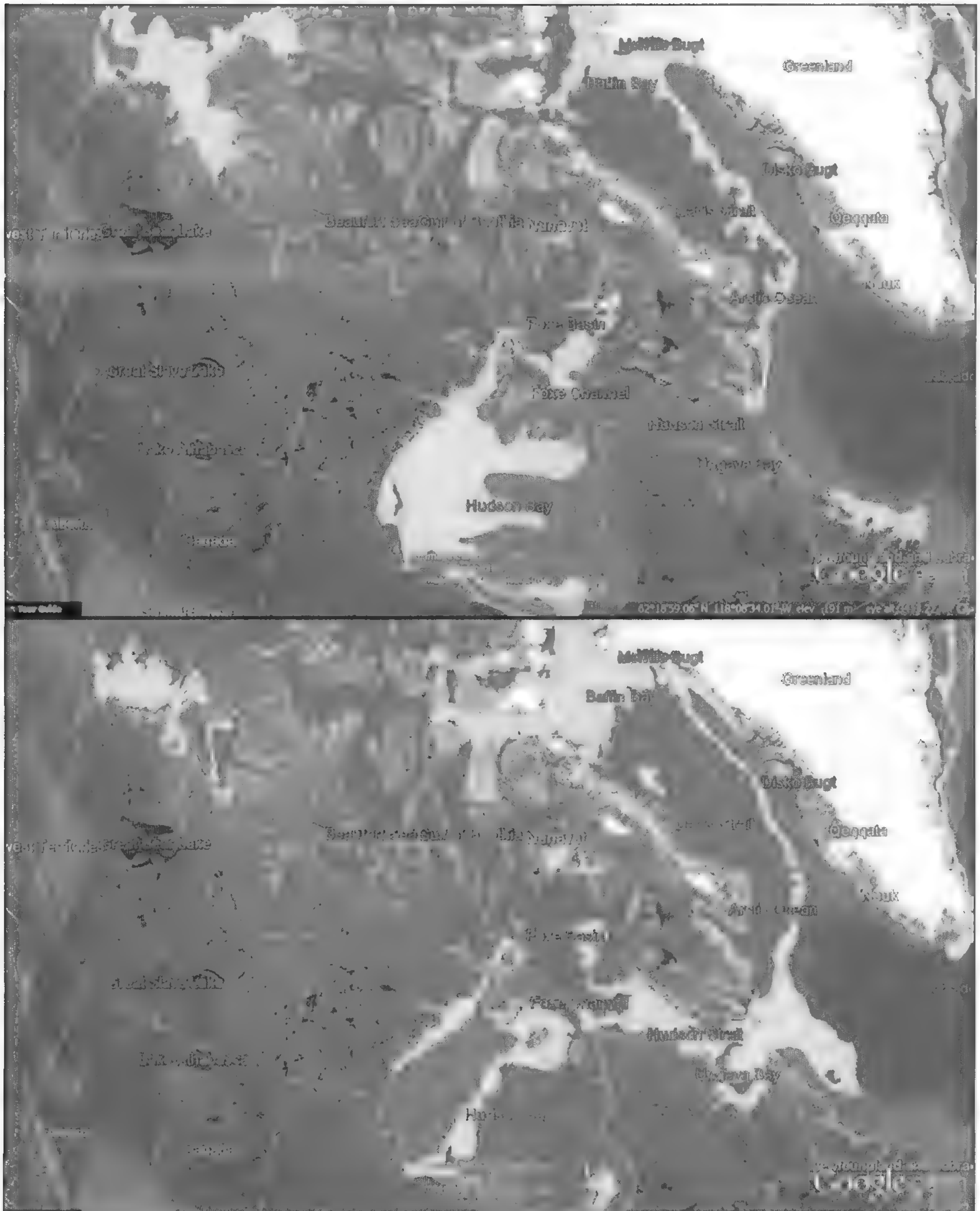

Figure 11. Representation of the less severe ice conditions seen at the beginning of the season, as seen on July 1, 2010 (top) July 1, 2015 (bottom).

Comprehensive SAR Risk Estimation

Impact						
	Extreme					
	High		9,10,11,12,22,23	21,24		
	Moderate					
	Low		1	2,3,4		
	Negligible					
		Rare	**Unlikely**	**Moderate**	**Likely**	**Almost Certain**
		Likelihood				

Note: The RAMSARD process is not a relative risk tool, and should not be used to compare area risks to other area risks or to the national risk matrix. Each area has unique risks and may have unique resources to cover those risks. During consultations with stakeholders, the national risk matrix will be shown only to indicate that it is complete and to show that local figures are used in the Analysis (as opposed to the national figures being applied to local area assessments).

CATEGORY			
1	M1 - Pleasure Craft	**15**	M3 - Major Ferry - Oil Rig
2	M2 - Pleasure Craft	**16**	M4 -Major Ferry - Oil Rig
3	M3 - Pleasure Craft	**17**	A1 - Small Aircraft
4	M4 - Pleasure Craft	**18**	A2 - Small Aircraft
5	M1 - Fishing Vessel	**19**	A3 - Small Aircraft
6	M2 - Fishing Vessel	**20**	A4 - Small Aircraft
7	M3 - Fishing Vessel	**21**	A1 - Large Aircraft
8	M4 - Fishing Vessel	**22**	A2 - Large Aircraft
9	M1 - Commercial Vessel	**23**	A3 - Large Aircraft
10	M2 - Commercial Vessel	**24**	A4 - Large Aircraft
11	M3 - Commercial Vessel	**25**	H1 - Humanitarian
12	M4 - Commercial Vessel	**26**	H2 - Humanitarian
13	M1 - Major Ferry - Oil Rig	**27**	H3 - Humanitarian
14	M2 - Major Ferry - Oil Rig	**28**	H4 - Humanitarian

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This Risk Assessment is based on the parameters:

Table 1 – Impact

Impact	
Extreme	More than 50 lives lost in incident.
High	More than 10 lives lost in incident.
Moderate	More than 5 lives lost in incident.
Low	One to five lives lost in incident.
Negligible	No lives lost in incident.

If the data is absent, all reviewers will be required to use the following assumptions for determining consequences:

- A pleasure craft has four persons on board;
- A fishing vessel has five persons on board;
- A commercial vessel has twenty persons on board;
- A cruise ship, ferry or oil rig has more than fifty persons on board;
- A small aircraft carries ten or fewer persons; and
- A large aircraft carries more than ten persons.

Table 2 – Likelihood

Likelihood	
Almost Certain	1 incident or more per week
Likely	1 or more incident per month
Moderate	1 or more incident per year
Unlikely	1 incident every 10 years
Rare	1 incident every 25 years or more

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ANNEX: Western Nunavut / Hudson Bay Expanded Regional SAR Case Profile: 2006 – 2016.

Air – 205; Marine – 137; Humanitarian – 84; Unknown - 16

Year	Final Classification	Incident Type	Craft Category	Craft Sub-Category	Craft Type	Action Taken
2016	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	False Alarm	Other	Air (Government/Military)	Unknown	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	M5	False Alarm	(blank)	(blank)	(blank)	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A1P	Crash	Air	Air (Commercial)	Helicopter	None
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	H3	Disabled	Pleasure	Hunting	Open Boat	Communication
	A5	Other	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	H3	Medical	Other	None/Not Applicable	Transport Persons	Transport of Person(s)
	H4	False Alarm	Other	None/Not Applicable	PLB Search	Investigation
	H4	False Alarm	Other	None/Not Applicable	PLB Search	Communication
	H2	Other	Pleasure	Pleasure	Motor Craft	Search
	M3	Disabled	Pleasure	Hunting	Canoe	Monitoring
	M3	Stranded	Pleasure	Pleasure	Motor Craft	Towed
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Single Engine Aircraft	Investigation

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	M2	Stranded	**Pleasure**	Hunting	**Motor Craft**	Rescue
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Search
	M2	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Escort
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Towed
	M4	Other	**Pleasure**	Pleasure	**Motor Craft**	Investigation
	M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Technical Assistance
	M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Escort
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Search
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
2015	**H2**	Stranded	**Other**	None/Not Applicable	**Other**	Rescue
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Assist Police**	Monitoring
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation

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A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	None
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M2	Disabled	**Pleasure**	Hunting	**Motor Craft**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Communication
H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**Other**	Air (Government/Military)	**Unknown**	Investigation
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M3	Other	**Pleasure**	Hunting	**Canoe**	Search
M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Resupply
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M3	Medical	**Commercial**	Pleasure	**Cruise Ship**	Communication
A5	Other	**Other**	Unknown	**Other**	Investigation
M2	Stranded	**Pleasure**	Hunting	**Motor Craft**	Monitoring
M2	Stranded	**Pleasure**	Hunting	**Motor Craft**	Search
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Government	**Tanker**	Communication
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M2	Other	**Pleasure**	Unknown	**Motor Craft**	Rescue
M2	Disabled	**Pleasure**	Hunting	**Motor Craft**	Search
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	False	**Air**	Air (Commercial)	**Helicopter**	Investigation

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		Alarm				
	M4	Medical	**Other**	None/Not Applicable	**Nil**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
2014	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation
	H4	False Alarm	**Other**	None/Not Applicable	**Other**	Investigation
	H4	False Alarm	**Other**	None/Not Applicable	**PLB Search**	Investigation
	H4	False Alarm	**Other**	None/Not Applicable	**PLB Search**	Investigation

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	H4	False Alarm	**Other**	None/Not Applicable	**PLB Search**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Communication
	M2	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Communication
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	Other	**Pleasure**	Pleasure	**Motor Craft**	Communication
	H3	Medical	**Pleasure**	Hunting	**Motor Craft**	Transport of Person(s)
	M4	False Alarm	**Pleasure**	Hunting	**Motor Craft**	Investigation
	M3	Grounded	**Commercial**	Marine Transportation	**Cargo Ship**	Refloated
	M3	Stranded	**Pleasure**	Hunting	**Motor Craft**	Search
	H3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Hunting	**Open Boat**	Towed
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M1	Man Overboard	**Pleasure**	Pleasure	**Motor Craft**	Search
2013	A1	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False	**Air**	Air (Commercial)	**Multi-**	Investigation

	Alarm			**Engine Aircraft**	
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
H3	Stranded	**Other**	None/Not Applicable	**Assist Police**	Monitoring
H3	Missing Person(s)	**Other**	None/Not Applicable	**Assist Police**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Communication
A4	False Alarm	**Air**	Government	**Helicopter**	Investigation
H1	Medical	**Other**	None/Not Applicable	**Evacuation**	Other
M1	Stranded	**Pleasure**	Hunting	**Open Boat**	Rescue
M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Towed
M3	Stranded	**Pleasure**	Hunting	**Open Boat**	Evacuation
M4	Other	**Pleasure**	None/Not Applicable	**Personal Watercraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Communication
A1P	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Other
M3	Other	**Pleasure**	Hunting	**Canoe**	Investigation
H4	False Alarm	**Other**	None/Not Applicable	**PLB Search**	Monitoring
A4	False Alarm	**Other**	Air (Commercial)	**Unknown**	Investigation
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
H1	Missing Person(s)	**Other**	None/Not Applicable	**Assist Police**	Search
A1	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Search
M2	Other	**Pleasure**	Pleasure	**Motor Craft**	Search
M3	Disabled	**Pleasure**	Unknown	**Motor Craft**	Search
M3	Other	**Pleasure**	Hunting	**Motor Craft**	Other
M4	False Alarm	**Pleasure**	Pleasure	**Motor Craft**	Investigation
H1	Stranded	**Other**	None/Not Applicable	**Evacuation**	Rescue
H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
M2	Stranded	**Pleasure**	Pleasure	**Personal**	Rescue

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					Watercraft	
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Monitoring
	A5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	M3	Other	**Pleasure**	Pleasure	**Open Boat**	Search
	M2	Other	**Pleasure**	Commercial Fishing Other	**Motor Craft**	Search
	M4	False Alarm	**Other**	Unknown	**Unknown**	Communication
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Communication
	A4	False Alarm	**Air**	Government	**Helicopter**	Investigation
2012	**A4**	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A2	Other	**Air**	Air (Government/Military)	**Helicopter**	Communication
	H1	Stranded	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M2	Other	**Pleasure**	Hunting	**Motor Craft**	Search
	A4	False Alarm	**Air**	Pleasure	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	Other	**Pleasure**	Hunting	**Motor Craft**	Search
	M2	Stranded	**Pleasure**	Hunting	**Motor Craft**	Monitoring
	M2	Other	**Pleasure**	Unknown	**Motor Craft**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M4	Other	**Commercial**	Marine Transportation	**Tanker**	Investigation
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Other	**Pleasure**	Unknown	**Motor Craft**	Towed

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	M3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M2	Stranded	**Pleasure**	Hunting	**Motor Craft**	Rescue
	A3	Forced Landing	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M2	Medical	**Government**	Government	**Government Vessel**	Evacuation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Pleasure**	Unknown	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communication
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	Other	**Government**	Government	**Government Vessel**	Communication
	A4	Airborne Emergency	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Search
	M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Towed
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Communication
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Monitoring
	A5	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Communication
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Search
	M2	Taking on Water	**Pleasure**	Pleasure	**Motor Craft**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
2011	**A4**	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H2	Stranded	**Other**	None/Not Applicable	**Missing Person**	Communication

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A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
H3	Other	**Other**	None/Not Applicable	**Missing Person**	Monitoring
H2	Missing Person(s)	**Other**	None/Not Applicable	**PLB Search**	Investigation
H2	Stranded	**Other**	None/Not Applicable	**Evacuation**	Technical Assistance
H3	Other	**Other**	None/Not Applicable	**PLB Search**	Communication
H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
H1	Other	**Other**	None/Not Applicable	**PLB Search**	Communication
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A3	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Communication
M5	Other	**(blank)**	(blank)	**(blank)**	Communication
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Communication
M3	Other	**Pleasure**	Hunting	**Canoe**	Search
M3	Disabled	**Pleasure**	Hunting	**Canoe**	Towed
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
M3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Search
M4	False Alarm	**Pleasure**	Pleasure	**Motor Craft**	Investigation
A1	On Fire	**Air**	Air (Commercial)	**Helicopter**	Investigation
M3	Other	**Pleasure**	Hunting	**Motor Craft**	Search
M3	Disabled	**Pleasure**	Hunting	**Open Boat**	Search
M3	Disabled	**Pleasure**	Hunting	**Motor Craft**	Transport of Person(s)
A5	Other	**(blank)**	(blank)	**(blank)**	Communication
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
M3	Stranded	**Pleasure**	Unknown	**Canoe**	Search
A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M2	Other	**Pleasure**	Pleasure	**Motor Craft**	Search
A1	Crash	**(blank)**	(blank)	**(blank)**	Search
M3	Missing Person(s)	**Pleasure**	Hunting	**Motor Craft**	Search
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation

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	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Hunting	**Open Boat**	Resupply
	H4	Other	**Pleasure**	Pleasure	**Motor Craft**	Investigation
	A3	Forced Landing	**Air**	Air (Commercial)	**Single Engine Aircraft**	Assist Another JRCC/MRSC
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Rescue
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Communication
	M1	Capsized	**Pleasure**	Pleasure	**Motor Craft**	Search
	M3	Stranded	**Pleasure**	Hunting	**Motor Craft**	Communication
	M2	Missing Person(s)	**Pleasure**	Hunting	**Motor Craft**	Search
	M2	Other	**Pleasure**	Hunting	**Open Boat**	Search
	M1	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Rescue
2010	**A4**	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H1	Stranded	**Other**	None/Not Applicable	**Missing Person**	Rescue
	H3	Disabled	**Other**	None/Not Applicable	**PLB Search**	Technical Assistance
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H3	Disabled	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H3	Disabled	**Other**	None/Not Applicable	**PLB Search**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	H3	Disabled	**Other**	None/Not Applicable	**PLB Search**	Monitoring
	A4	Other	**Air**	Unknown	**Helicopter**	Investigation
	M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Escort
	M3	Other	**Pleasure**	Pleasure	**Open Boat**	Investigation
	A1P	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	None
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Search
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Search
	M5	Other	**(blank)**	(blank)	**(blank)**	None
	M5	Other	**(blank)**	(blank)	**(blank)**	Communication

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	M3	Stranded	**Pleasure**	Pleasure	**Open Boat**	Search
	M2	On Fire	**Commercial**	Marine Transportation	**Tanker**	Communication
	A1P	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Monitoring
	M3	Grounded	**Commercial**	Marine Transportation	**Tanker**	Investigation
	M3	Missing Person(s)	**Pleasure**	Hunting	**Open Boat**	Search
	M5	Other	**(blank)**	(blank)	**(blank)**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M1P	Medical	**Pleasure**	Hunting	**Motor Craft**	None
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Search
	M4	Missing Person(s)	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M2	Grounded	**Commercial**	Marine Transportation	**Cruise Ship**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Communication
	A4	False Alarm	**Other**	Unknown	**Unknown**	Monitoring
	M2	Medical	**Commercial**	Marine Transportation	**Tug**	First Aid
	H2	Other	**Other**	None/Not Applicable	**Other**	Investigation
	H3	Other	**Other**	None/Not Applicable	**PLB Search**	Monitoring
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	H3	Disabled	**Other**	None/Not Applicable	**PLB Search**	Communication
	H3	Stranded	**Other**	None/Not Applicable	**PLB Search**	Search
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
2009	**A4**	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Communication
	U4	False Alarm	**Other**	Unknown	**Unknown**	Monitoring
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1	Missing Person(s)	**Air**	Air (Commercial)	**Multi-Engine**	Investigation

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				Aircraft	
H5	Other	**(blank)**	(blank)	**(blank)**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A3	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Monitoring
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M3	Other	**Pleasure**	Pleasure	**Sail Craft**	Communication
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communication
M3	Other	**Pleasure**	Pleasure	**Open Boat**	Communication
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communication
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
A3	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Assistance in Ice
A5	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
M1	Medical	**Commercial**	Marine Transportation	**Tanker**	Evacuation
M2	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Transport of Person(s)
M5	Other	**Fishing**	Unknown	**Fishing Vessel**	Communication
M5	False Alarm	**(blank)**	(blank)	**(blank)**	Communication
A4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation

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	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H3	Other	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H3	Disabled	**Other**	None/Not Applicable	**Missing Person**	Technical Assistance
	H3	Stranded	**Other**	None/Not Applicable	**Missing Person**	Resupply
	H3	Disabled	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Homing
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
	A1P	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	None
	H2	Stranded	**Other**	None/Not Applicable	**Evacuation**	Communication
	H3	Other	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H2	Other	**Other**	None/Not Applicable	**Missing Person**	Rescue
	H2	Disabled	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H1	Stranded	**Other**	None/Not Applicable	**Missing Person**	Search
	M2	Stranded	**Pleasure**	Marine Transportation	**Motor Craft**	Rescue
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	M2	Disabled	**Pleasure**	Pleasure	**Canoe**	Search
2008	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**Other**	Unknown	**Unknown**	Investigation
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine**	Investigation

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				Aircraft	
M3	Stranded	**Pleasure**	None/Not Applicable	**Motor Craft**	Rescue
M4	False Alarm	**Pleasure**	None/Not Applicable	**Sail Craft**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Pleasure	**Multi-Engine Aircraft**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Other
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
H3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Unknown	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Unknown	**Multi-Engine Aircraft**	Investigation
H5	Other	**(blank)**	(blank)	**(blank)**	Monitoring
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
A1P	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Monitoring
U4	Other	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Communication
U4	Other	**Other**	Unknown	**Unknown**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A4	Other	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Government	**Multi-Engine Aircraft**	Investigation
A4	Missing Person(s)	**Air**	Pleasure	**Single Engine Aircraft**	Investigation

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A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Search
A5	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	None
A4	Airborne Emergency	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Homing
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Other
H3	Disoriented	**Other**	None/Not Applicable	**Missing Person**	Monitoring
H3	Other	**Other**	None/Not Applicable	**Missing Person**	Search
H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
H3	Missing Person(s)	**Other**	None/Not Applicable	**Person**	Search
M4	Other	**Other**	None/Not Applicable	**Unknown**	Communication
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Monitoring
A4	False Alarm	**Air**	Unknown	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine**	Investigation

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					Aircraft	
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Search
	A3	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Homing
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	M3	Stranded	**Other**	Marine Transportation	**Unknown**	Search
	H4	Other	**Pleasure**	Hunting	**Motor Craft**	Investigation
	H2	Stranded	**Other**	None/Not Applicable	**PLB Search**	Investigation
	H2	Stranded	**Other**	None/Not Applicable	**PLB Search**	Monitoring
	H3	Disabled	**Other**	None/Not Applicable	**Missing Person**	Investigation
	H1	Medical	**Other**	None/Not Applicable	**Evacuation**	Communication
	H3	Disabled	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Other**	Air (Commercial)	**Unknown**	Homing
	H3	Medical	**Other**	None/Not Applicable	**Person**	Monitoring
	U4	False Alarm	**Other**	Unknown	**Unknown**	Homing
2007	**M5**	Other	**Other**	None/Not Applicable	**Nil**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	M3	Other	**Commercial**	Marine Transportation	**Cargo Ship**	Communication
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Communication
	M3	Other	**Pleasure**	Hunting	**Motor Craft**	Communication
	M4	False Alarm	**Commercial**	Marine Transportation	**Tug**	Communication
	M2	Disabled	**Pleasure**	Hunting	**Open Boat**	Search
	M3	Disabled	**Pleasure**	Hunting	**Open Boat**	Evacuation
	M3	Stranded	**Pleasure**	Hunting	**Motor Craft**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation

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	A2	Forced Landing	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H1	Missing Person(s)	**Other**	Hunting	**Person**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Homing
	A3	Forced Landing	**Air**	Air (Commercial)	**Single Engine Aircraft**	Monitoring
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Rescue
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	None
	H3	Stranded	**Other**	None/Not Applicable	**Transport Equipment**	Communication
	H5	Other	**(blank)**	(blank)	**(blank)**	Communication
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Rescue
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	H1	Missing Person(s)	**Other**	Pleasure	**Person**	Search
	H1	Medical	**Other**	None/Not Applicable	**Evacuation**	Investigation
2006	**H4**	False Alarm	**(blank)**	(blank)	**(blank)**	Monitoring
	H4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	H3	Other	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation

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3. EASTERN NUNAVUT / HUDSON BAY

Summary: Since 2006, there have been 182 marine SAR cases in the Eastern Nunavut region, which includes the Eastern waters of Hudson Bay, Hudson Strait and Foxe Basin. There have also been 176 Aeronautical SAR cases in this time period; with most cases occurring in inland regions, and very few on or near Arctic waters. The number of aeronautical SAR cases is also skewed due to 147 A4/A5 cases occurring during this time period, which are considered false alarms.

Examining the risk assessment heat map for the region, the maritime RAMSARD risk assessment for the pleasure crafts in the region is generally on the higher end of low, with some medium risks attributed to inland aircraft SAR cases and commercial vessels. Although some fishing vessel activity has been reported, SAR cases within this category are very infrequent with a low impact.

Impact		Rare	Unlikely	Moderate	Likely	Almost Certain
	Extreme					
	High		Commercial Vessel (M1-M3) Large Aircraft (A2)	Large Aircraft (A1, A3)		
	Moderate					
	Low		Fishing Vessel (M2, M3)	Pleasure Craft (M1-M3)		
	Negligible					
		Likelihood				

Location-Specific SAR Statistical Support

Map of SAR Cases 2006-2016:

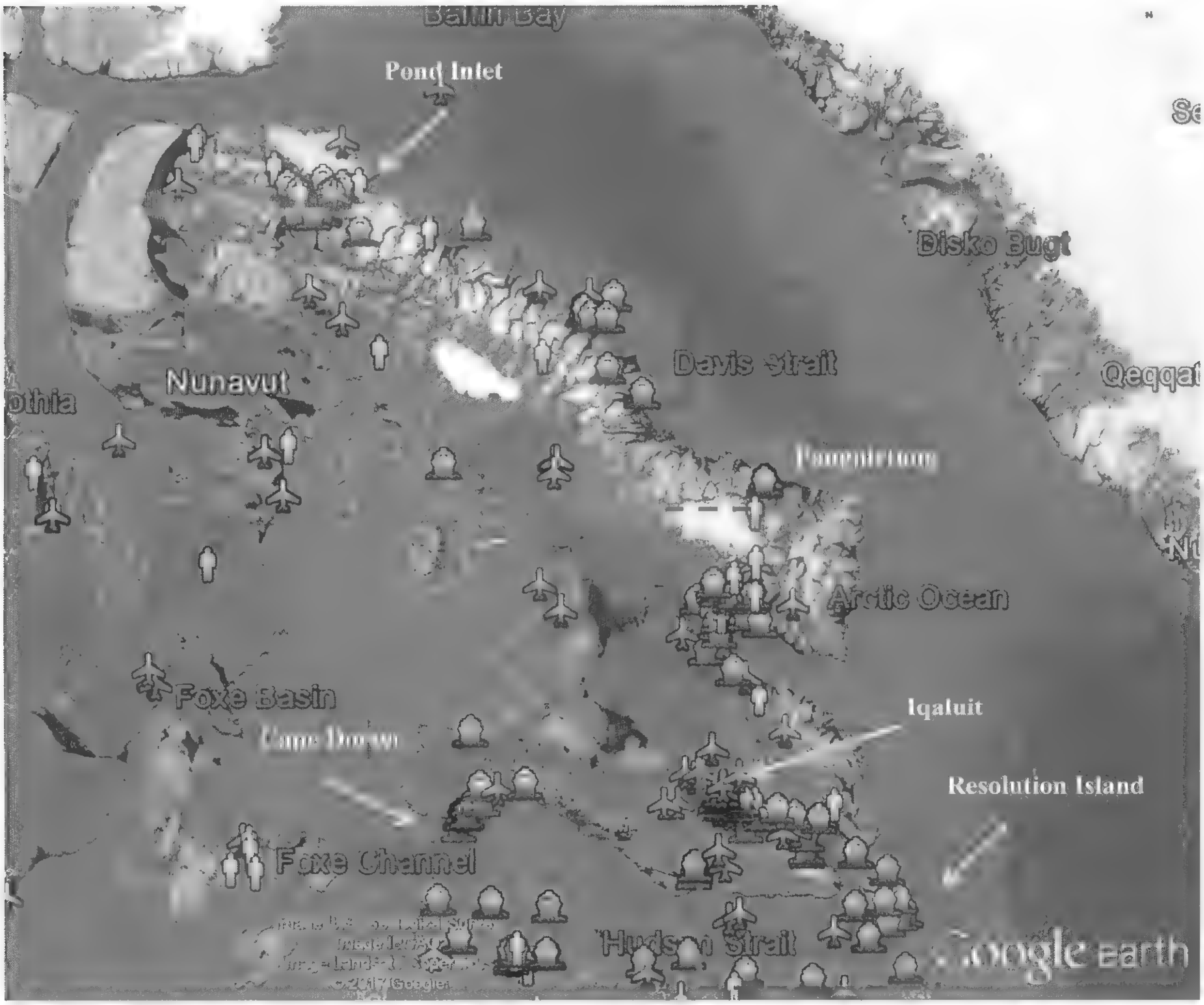
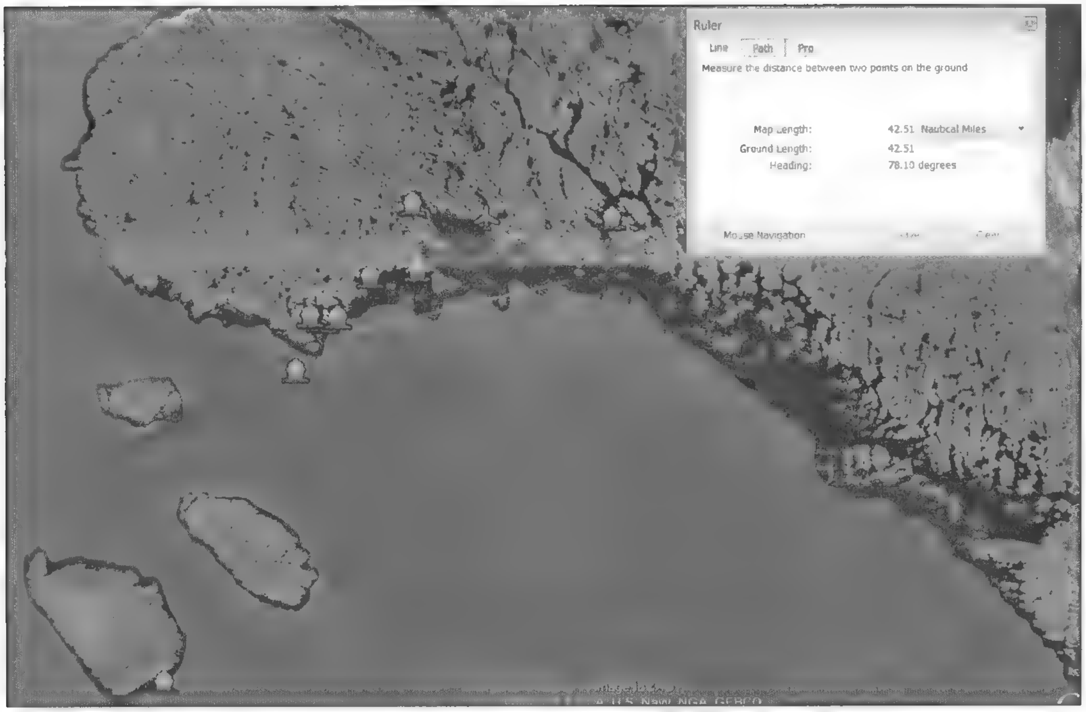


Figure 12. Map of SAR Cases 2006-2016.

Examining the historical SAR case data from the Eastern Nunavut region, a number of cases appear clustered in areas of Cape Dorset, Iqaluit, Pond Inlet, Pangnirtung and Resolution Island. Examining each area more closely reveals that many cases are within a reasonable response distance if a unit were available in these communities.

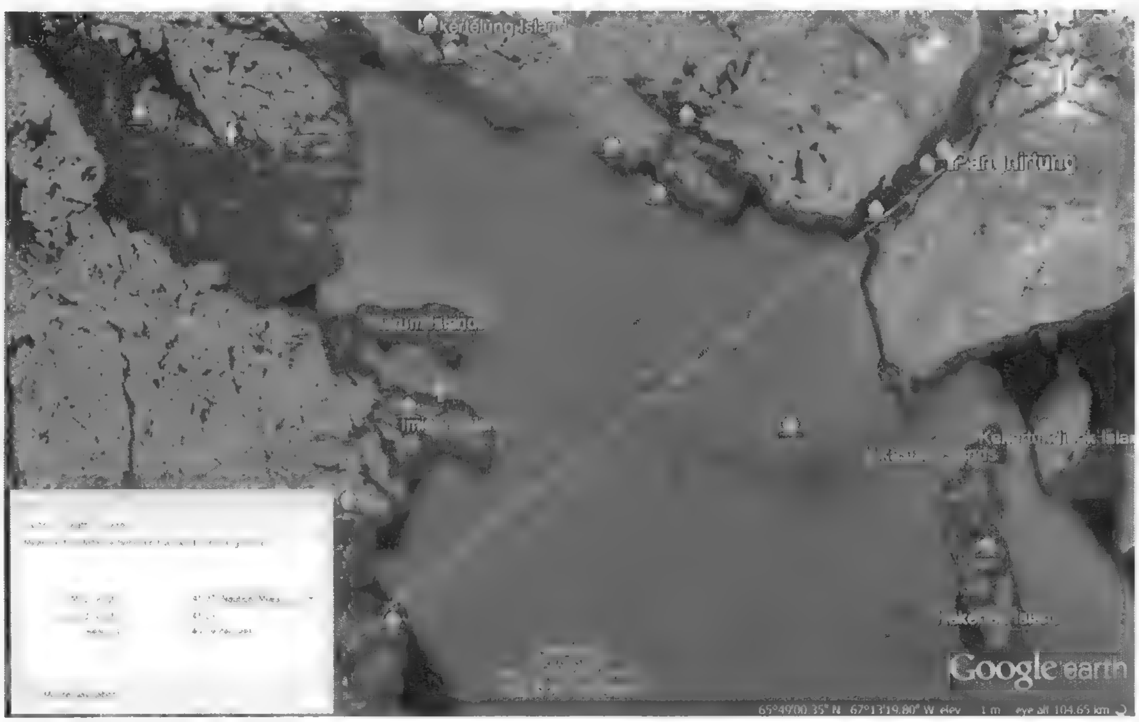
Cape Dorset: *Distance 40nm*



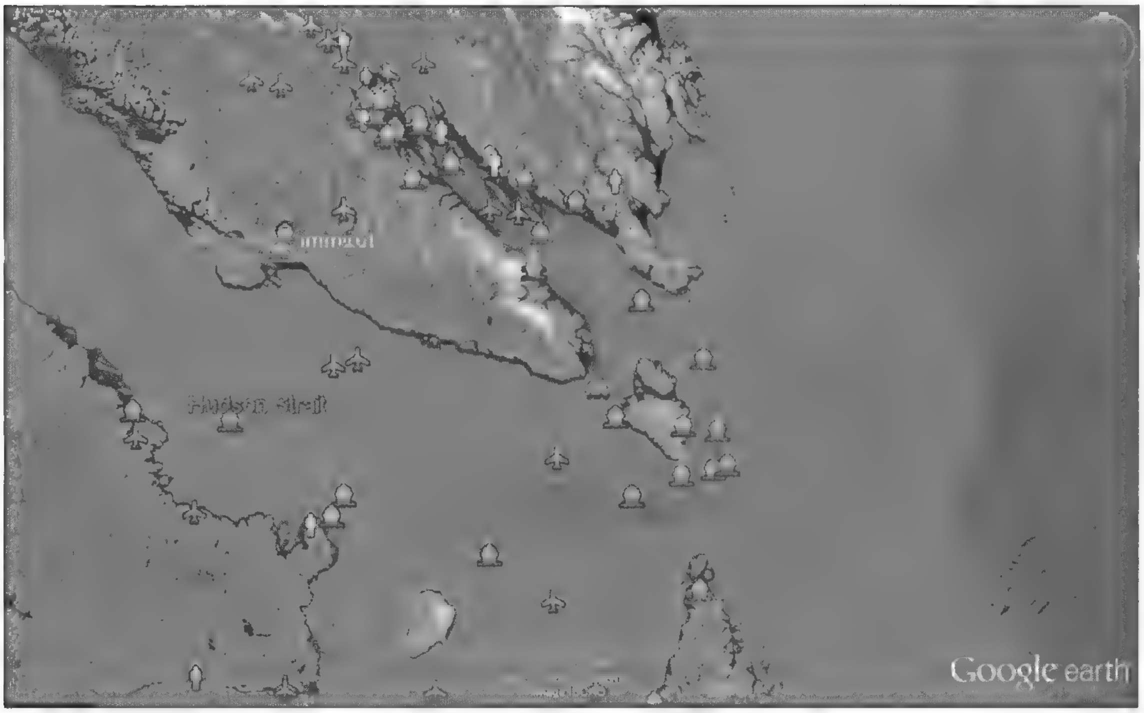
Iqaluit: *Distance 20nm*

Pond Inlet: *Distance 35nm*

Pangnirtung: *Distance 40nm*



Resolution Island: *Distance approximately 120nm*



It should be noted that the area of Resolution Island is roughly equidistant and approximately 120nm from any sizable community, including Iqaluit, Kimmirut and Kangiqsualujjuaq. These are the communities closest to respond to a marine occurrence in this region.

The figure below identifies the response range of both existing CCGA units (red) and CCGA units currently being established (i.e., not online and fully trained) (yellow). Once online, these units will provide a formalized response capacity in some of the areas identified. As of August 2017, the following communities have CCGA units who are in the process of formation: Pond Inlet, Clyde River, Igloolik, and Hall Beach.

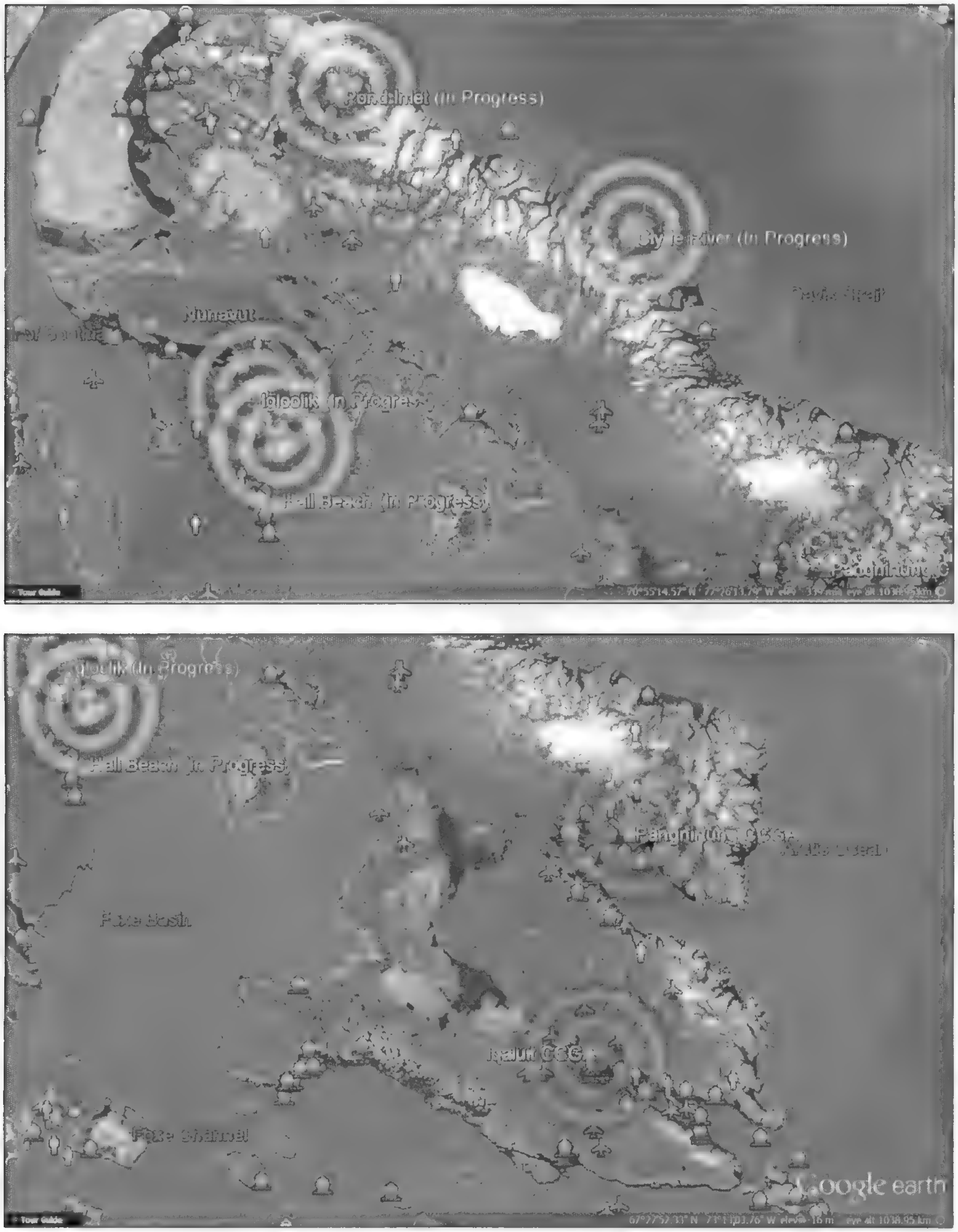


Figure 13. Existing and 'In Progress' CCGA units in Eastern Nunavut Region for the areas of interest.

Ice Conditions

Examining the historical ice conditions around the region, it appears that the ice conditions in the region are fairly consistent and do not vary considerably due to geography. However, there is a high-level of variation year over year, as evidenced by the first four images. Extended icing conditions are prevalent in much of the region, and early freezing in the fall results in a shortened ice-free season, limiting maritime operations.

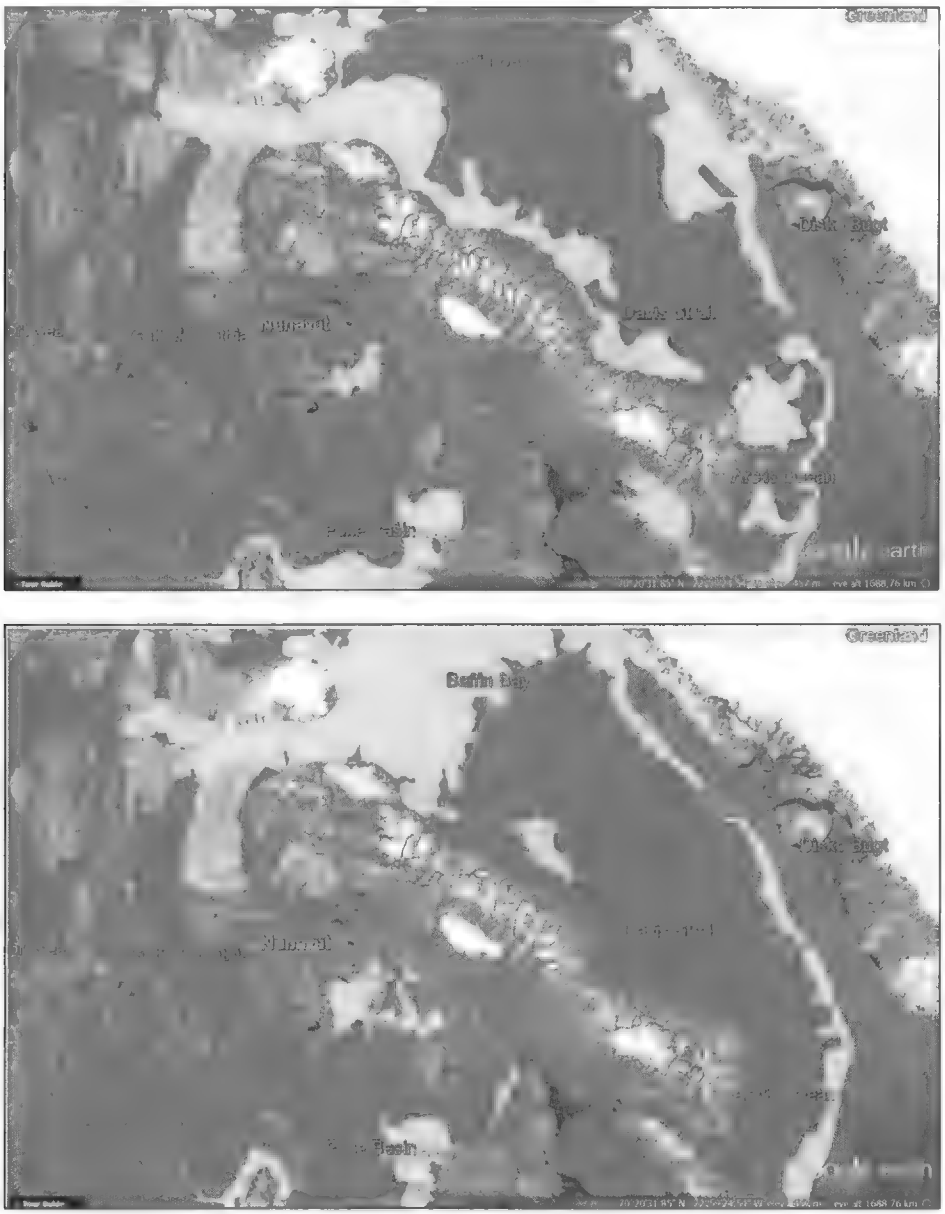


Figure 14. Representation of the more severe ice conditions seen at the beginning of the season, as seen on July 1, 2011 (top) and July 1, 2015 (bottom).

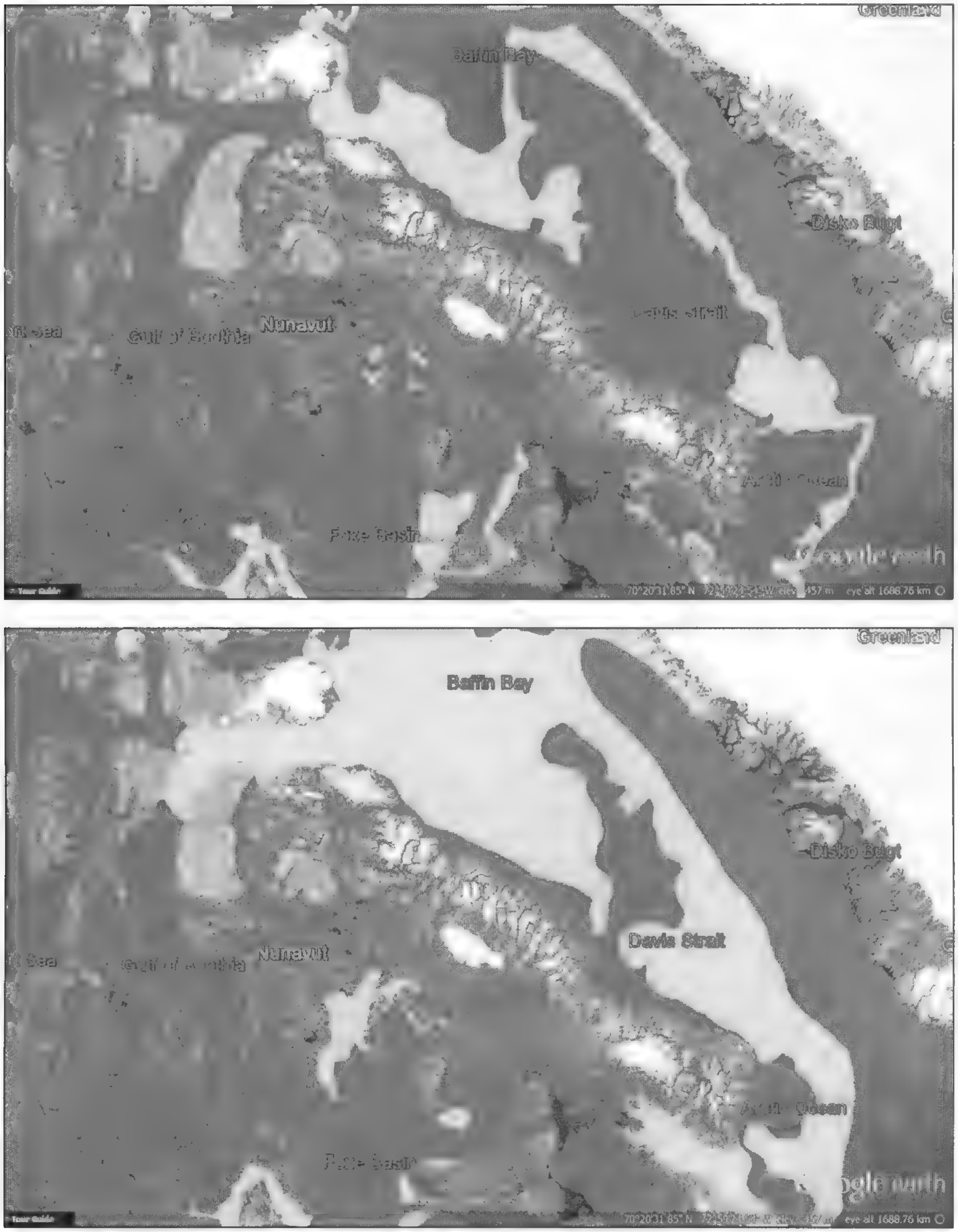


Figure 15. Representation of the less severe ice conditions seen at the beginning of the season, as seen on July 1, 2010 (top) July 1, 2014 (bottom).

Although the images above were all generated on July 1st, in some years there is a significant time delay until ice-free conditions exist. The following ice charts depict the ice conditions that existed on August 1, 2014 and August 16, 2017 – well into the typical marine navigation season – which would limit the operational season of any asset.

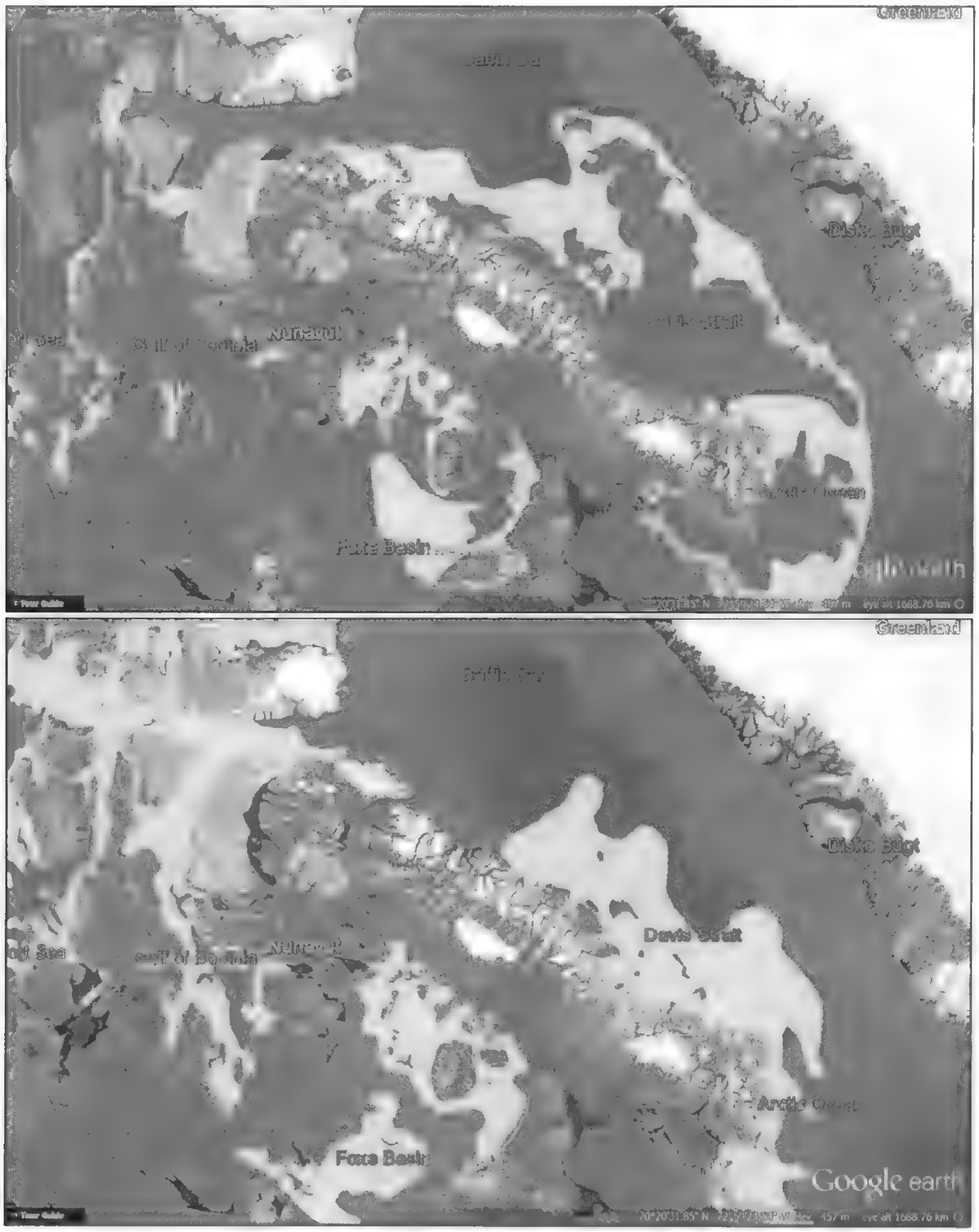


Figure 16. Representation of the ice conditions seen in the middle of the operating season, as seen on August 1, 2014 (top) August 16, 2017 (bottom).

Comprehensive SAR Risk Estimation

Impact						
	Extreme					
	High		9,10,11,22,	21,23		
	Moderate					
	Low		[illegible]	[illegible]		
	Negligible					
		Rare	Unlikely	Moderate	Likely	Almost Certain
		Likelihood				

Note: The RAMSARD process is not a relative risk tool, and should not be used to compare area risks to other area risks or to the national risk matrix. Each area has unique risks and may have unique resources to cover those risks. During consultations with stakeholders, the national risk matrix will be shown only to indicate that it is complete and to show that local figures are used in the Analysis (as opposed to the national figures being applied to local area assessments).

CATEGORY			
1	M1 - Pleasure Craft	**15**	M3 - Major Ferry - Oil Rig
2	M2 - Pleasure Craft	**16**	M4 -Major Ferry - Oil Rig
3	M3 - Pleasure Craft	**17**	A1 - Small Aircraft
4	M4 - Pleasure Craft	**18**	A2 - Small Aircraft
5	M1 - Fishing Vessel	**19**	A3 - Small Aircraft
6	M2 - Fishing Vessel	**20**	A4 - Small Aircraft
7	M3 - Fishing Vessel	**21**	A1 - Large Aircraft
8	M4 - Fishing Vessel	**22**	A2 - Large Aircraft
9	M1 - Commercial Vessel	**23**	A3 - Large Aircraft
10	M2 - Commercial Vessel	**24**	A4 - Large Aircraft
11	M3 - Commercial Vessel	**25**	H1 - Humanitarian
12	M4 - Commercial Vessel	**26**	H2 - Humanitarian
13	M1 - Major Ferry - Oil Rig	**27**	H3 - Humanitarian
14	M2 - Major Ferry - Oil Rig	**28**	H4 - Humanitarian

This Risk Assessment is based on the parameters:

Table 1 – Impact

Impact	
Extreme	More than 50 lives lost in incident.
High	More than 10 lives lost in incident.
Moderate	More than 5 lives lost in incident.
Low	One to five lives lost in incident.
Negligible	No lives lost in incident.

If the data is absent, all reviewers will be required to use the following assumptions for determining consequences:

- A pleasure craft has four persons on board;
- A fishing vessel has five persons on board;
- A commercial vessel has twenty persons on board;
- A cruise ship, ferry or oil rig has more than fifty persons on board;
- A small aircraft carries ten or fewer persons; and
- A large aircraft carries more than ten persons.

Table 2 – Likelihood

Likelihood	
Almost Certain	1 incident or more per week
Likely	1 or more incident per month
Moderate	1 or more incident per year
Unlikely	1 incident every 10 years
Rare	1 incident every 25 years or more

ANNEX: Eastern Nunavut / Hudson Bay Expanded Regional SAR Case Profile: 2006 – 2016.

Air – 176; Marine – 182; Humanitarian – 40; Unknown – 26

Year	Final Classification	Incident Type	Craft Category	Craft Sub-Category	Craft Type	Action Taken
2006	M4	False Alarm	Fishing	Commercial Fishing Other	Fishing Vessel	Investigation
	H1	Stranded	Other	Pleasure	Person	Rescue
	A4	False Alarm	Other	Unknown	Unknown	Investigation
	U4	False Alarm	Other	Unknown	Unknown	Investigation
	A3	Airborne Emergency	Air	Air (Government/Military)	Multi-Engine Aircraft	Monitoring
	A4	False Alarm	Air	Unknown	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A1	Crash	Air	Unknown	Single Engine Aircraft	Recovery
	U4	False Alarm	(blank)	(blank)	(blank)	Investigation
	M4	False Alarm	Fishing	Commercial Fishing Other	Fishing Vessel	Investigation
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation
	A3	Forced Landing	Air	Unknown	Single Engine Aircraft	Investigation
	A3	Other	Air	Unknown	Single Engine Aircraft	Search
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Government/Military)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Search
	A4	False Alarm	Air	Unknown	Multi-Engine Aircraft	Investigation
	M2	Medical	Government	Government	Government Vessel	Evacuation
	A1	Crash	Air	Unknown	Single Engine Aircraft	Rescue
	A1P	Forced Landing	Air	Air (Commercial)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Homing
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Homing

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	H1	Medical	**Other**	Unknown	**Evacuation**	Evacuation
	M4	False Alarm	**Pleasure**	Pleasure	**Sail Craft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1P	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	None
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
	M2	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Evacuation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Other	**Air**	Unknown	**Multi-Engine Aircraft**	Investigation
	A2	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	U4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Fishing**	Ground Fishing	**Fishing Vessel**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M1	Other	**Commercial**	Marine Transportation	**Bulk Carrier**	Rescue
	M1	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Search
2007	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
	M3	Medical	**Pleasure**	Marine Transportation	**Motor Craft**	Technical Assistance
	H1	Missing Person(s)	**Pleasure**	Pleasure	**Motor Craft**	Investigation
	A5	Airborne Emergenc y	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Airborne Emergenc y	**(blank)**	(blank)	**(blank)**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Cargo Ship**	Communicatio n
	M3	Grounded	**Commercial**	Marine Transportation	**Tug**	Monitoring
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine**	Homing

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					Aircraft	
	M2	Disabled	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Monitoring
	M3	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Escort
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M2	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communicatio n
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M5	False Alarm	**Fishing**	Unknown	**Fishing Vessel**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Homing
	M5	Grounded	**Commercial**	Unknown	**Ferry Boat**	Investigation
	M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	M1P	Capsized	**Commercial**	Marine Transportation	**Tug**	None
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**Other**	Unknown	**Nil**	Investigation
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	H4	False Alarm	**Other**	None/Not Applicable	**Other**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Resupply
	M5	Other	**(blank)**	(blank)	**(blank)**	Communicatio n
	M4	False Alarm	**Commercial**	None/Not Applicable	**Tug**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
2008	**A5**	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Homing
	A3	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A3	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation

	M2	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	H2	Stranded	**Other**	None/Not Applicable	**Evacuation**	Evacuation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M5	Other	**Fishing**	Unknown	**Fishing Vessel**	Investigation
	A5	Other	**Other**	None/Not Applicable	**Nil**	Investigation
	H2	Person in Water	**Other**	None/Not Applicable	**Other**	Rescue
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Homing
	A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	Other	**Other**	Air (Commercial)	**Unknown**	Investigation
	A5	Other	**Other**	Unknown	**Unknown**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Capsized	**Fishing**	Unknown	**Fishing Vessel**	Investigation
	A4	Other	**Other**	Unknown	**Nil**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
	A4	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	M2	Disabled	**Pleasure**	Hunting	**Canoe**	Monitoring
	A4	Other	**Other**	Unknown	**Unknown**	Monitoring
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A3	Airborne Emergenc y	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation

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	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Homing
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Communicatio n
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	H5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H3	Medical	**Other**	None/Not Applicable	**Evacuation**	Transport of Person(s)
	A5	Other	**Other**	Unknown	**Unknown**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	M5	Other	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
2009	**A5**	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Escort
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Technical Assistance
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
	H3	Other	**Other**	None/Not Applicable	**Evacuation**	Monitoring
	A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Homing
	A4	False	**Air**	Air (Commercial)	**Helicopter**	Investigation

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	Alarm				
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Homing
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
H3	Stranded	**Other**	None/Not Applicable	**Evacuation**	Evacuation
M3	Disabled	**Fishing**	Ground Fishing	**Fishing Vessel**	Towed
M3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	Other	**Other**	Unknown	**Unknown**	Search
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M5	False Alarm	**Commercial**	Marine Transportation	**Roro/Container**	Investigation
M3	Disabled	**Commercial**	Marine Transportation	**Bulk Carrier**	Monitoring
M5	Other	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
A4	Other	**Air**	Unknown	**Single Engine Aircraft**	Investigation
A4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	Other	**Other**	Unknown	**Nil**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Sailboard**	Investigation
H2	Medical	**Other**	None/Not Applicable	**Medevac**	Monitoring
M1	Capsized	**Pleasure**	Pleasure	**Kayak**	Rescue
U4	Other	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M5	Foundered	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
H3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Monitoring
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
A1P	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	None

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	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Search
	A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	M2	Other	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
	H1	Other	**Other**	None/Not Applicable	**Assist Police**	None
	A5	Other	**(blank)**	(blank)	**(blank)**	None
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Monitoring
	A5	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**Other**	Unknown	**Unknown**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H5	Other	**Other**	None/Not Applicable	**PLB Search**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
	M4	False Alarm	**Fishing**	None/Not Applicable	**Fishing Vessel**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Ferry Boat**	Investigation
2010	**U4**	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M5	False Alarm	**Commercial**	Unknown	**Tanker**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**Air**	Unknown	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	Disabled	**Other**	None/Not Applicable	**Nil**	Investigation

M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
A1	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	Other	**Other**	None/Not Applicable	**PLB Search**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A1P	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Tug**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M2	Disabled	**Pleasure**	Pleasure	**Canoe**	Search
M3	Other	**Pleasure**	Pleasure	**Canoe**	Monitoring
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Towed
M4	Other	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Other**	Unknown	**Nil**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
M2	Disabled	**Fishing**	Pleasure	**Fishing Vessel**	Investigation
A2	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	Medical	**Other**	None/Not Applicable	**Suicide or Attempt**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Other**	Unknown	**Unknown**	Investigation
M4	False Alarm	**Fishing**	None/Not Applicable	**Fishing Vessel**	Investigation

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	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Rescue
	A4	Other	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M2	Disabled	**Government**	Government	**Government Vessel**	Monitoring
	H4	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	M1	Person in Water	**Pleasure**	Unknown	**Kayak**	Search
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M5	False Alarm	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A2	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Investigation
2011	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Other**	Unknown	**Other**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M1	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Evacuation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
	M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation

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A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A1	Crash	**Other**	Air (Private/Pleasure)	**Other**	Investigation
A2	Airborne Emergenc y	**(blank)**	(blank)	**(blank)**	Monitoring
A4	False Alarm	**Other**	Air (Private/Pleasure)	**Other**	Investigation
A4	False , Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A5	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	Other	**Other**	Air (Private/Pleasure)	**Other**	Investigation
A4	Other	**Air**	Unknown	**Single Engine Aircraft**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Other
A4	Other	**Other**	Unknown	**Other**	Investigation
A4	False Alarm	**Other**	Air (Commercial)	**Other**	Investigation
A3	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Other**	Unknown	**Other**	Investigation
M4	False Alarm	**Pleasure**	Hunting	**Motor Craft**	Investigation
U4	Other	**Other**	Unknown	**Other**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
H2	Medical	**Other**	None/Not Applicable	**Evacuation**	Evacuation
H1	Suicide	**Other**	None/Not Applicable	**Suicide or Attempt**	Search
A1	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	Other	**Other**	Unknown	**Nil**	Investigation
H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Communicatio n

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	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Search
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	M1P	Capsized	**Pleasure**	Pleasure	**Kayak**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M1	Missing Person(s)	**Pleasure**	Hunting	**Open Boat**	Search
2012	**A4**	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A3	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Search
	M3	Disabled	**Pleasure**	Pleasure	**Personal Watercraft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Resupply
	M2	Medical	**Other**	Marine Transportation	**Other**	Evacuation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Pleasure	**Single Engine Aircraft**	Search
	M4	False Alarm	**Commercial**	Marine Transportation	**Tanker**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	False Alarm	**Pleasure**	Unknown	**Canoe**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation

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A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	Missing Person(s)	**(blank)**	(blank)	**(blank)**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Search
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Homing
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
U4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
M3	Disabled	**Pleasure**	Pleasure	**Personal Watercraft**	Towed
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M3	Disabled	**Other**	Unknown	**Unknown**	Monitoring
M4	False Alarm	**Pleasure**	Hunting	**Open Boat**	Other
M1	Capsized	**Pleasure**	Hunting	**Canoe**	Monitoring
A1P	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Monitoring
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Evacuation
M3	Other	**Pleasure**	Hunting	**Open Boat**	Search
H4	Other	**Pleasure**	Pleasure	**Open Boat**	Monitoring
M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Technical Assistance
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
M4	False Alarm	**Pleasure**	Hunting	**Motor Craft**	Search
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M2	Medical	**Commercial**	Marine Transportation	**Tug**	Evacuation
H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
A1P	Crash	**Other**	Air (Private/Pleasure)	**Other**	None
M4	Other	**Other**	Unknown	**Unknown**	Investigation
M1	Stranded	**Pleasure**	Pleasure	**Kayak**	Rescue
M1	Capsized	**Pleasure**	Hunting	**Motor Craft**	Rescue

	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Other**	Air (Government/Military)	**Unknown**	Investigation
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	Other	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
	A2	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
2013	**H1**	Other	**Other**	None/Not Applicable	**Transport Medical**	Transport of Person(s)
	A2	Airborne Emergency	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Monitoring
	A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	M4	False Alarm	**Commercial**	Unknown	**Tug**	Communication
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A5	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False	**Air**	Air (Commercial)	**Multi-Engine**	Investigation

	Alarm			**Aircraft**	
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
A5	False Alarm	**Other**	Unknown	**Unknown**	Other
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M1P	Capsized	**Pleasure**	Hunting	**Open Boat**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A1P	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Tanker**	Investigation
A1	Crash	**Air**	Air (Government/Militar y)	**Multi-Engine Aircraft**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communicatio n
M3	Disabled	**Pleasure**	Unknown	**Motor Craft**	Monitoring
A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
M1	Medical	**Commercial**	Marine Transportation	**Tanker**	Communicatio n
A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Other
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False	**Air**	Air (Commercial)	**Multi-Engine**	Investigation

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		Alarm			**Aircraft**	
	H1	Other	**Other**	None/Not Applicable	**Assist Police**	Monitoring
	A4	False Alarm	**Air**	Air (Government/Military)	**Helicopter**	Investigation
	M5	False Alarm	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Investigation
	M4	False Alarm	**Government**	None/Not Applicable	**Government Vessel**	Investigation
	A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A3	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Other**	Monitoring
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	H4	Other	**(blank)**	(blank)	**(blank)**	Monitoring
	M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
	U4	Other	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
	M4	False Alarm	**Government**	None/Not Applicable	**Government Vessel**	Investigation
2014	**A3**	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A2	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Monitoring
	H3	Other	**Other**	None/Not Applicable	**Assist Police**	Investigation
	A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation

A1	Crash	**Air**	Air (Private/Pleasure)	**Helicopter**	Recovery
H3	Other	**Other**	None/Not Applicable	**Evacuation**	Evacuation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
M1	Foundered	**Pleasure**	Pleasure	**Motor Craft**	Rescue
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Missing Person(s)	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	Medical	**Other**	None/Not Applicable	**Evacuation**	Investigation
M1	Medical	**Government**	Government	**Government Vessel**	Monitoring
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M2	Disabled	**Pleasure**	Diving	**Open Boat**	Escort
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Escort
M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Monitoring
M3	Other	**Pleasure**	Pleasure	**Sail Craft**	Monitoring
M2	Taking on Water	**Pleasure**	Government	**Motor Craft**	Communicatio n
M3	Disabled	**Pleasure**	Unknown	**Open Boat**	Monitoring
A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M3	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Monitoring
A2	Airborne Emergenc	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring

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		y				
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Search
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Open Boat**	Towed
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H1	Person in Water	**Other**	None/Not Applicable	**Suicide or Attempt**	Rescue
	A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Fishing**	????????	**Fishing Vessel**	Towed
	M3	Disabled	**Fishing**	????????	**Fishing Vessel**	Towed
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	H2	Capsized	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	A1	Crash	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Hunting	**Helicopter**	Rescue
2015	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	Other	**Air**	None/Not Applicable	**Single Engine Aircraft**	Investigation
	A4	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1	Forced Landing	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Person in Water	**Other**	None/Not Applicable	**Missing Person**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine**	Rescue

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				Aircraft	
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
M3	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	First Aid
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
A4	False Alarm	**Air**	Air (Government/Military)	**Helicopter**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
A1	Airborne Emergency	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Other
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M2	Disabled	**Government**	Government	**Government Vessel**	Search
A5	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
M2	Disabled	**Pleasure**	Hunting	**Motor Craft**	Rescue
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
H4	False Alarm	**Other**	None/Not Applicable	**Assist Police**	Search
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
H1	Other	**Other**	None/Not Applicable	**PLB Search**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Pleasure**	Unknown	**Open Boat**	Monitoring
H3	Body Recovery	**Other**	None/Not Applicable	**Assist Police**	Recovery
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
M1	Disabled	**Pleasure**	Hunting	**Open Boat**	Investigation
M1	Capsized	**Pleasure**	Pleasure	**Kayak**	Rescue

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	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A1	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	False Alarm	**Commercial**	Unknown	**Barge**	Search
	M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Refloated
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	H5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A1	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
	M3	Grounded	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Refloated
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Rescue
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
2016	**H2**	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Rescue
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Other
	A1P	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False	**Air**	Air (Private/Pleasure)	**Single Engine**	Investigation

	Alarm			**Aircraft**	
H1	Person in Water	**Other**	None/Not Applicable	**Other**	Communication
M3	Disabled	**Fishing**	Crab Fishing	**Fishing Vessel**	Towed
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A3	Airborne Emergency	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Monitoring
M3	Medical	**Government**	Government	**Government Vessel**	Monitoring
M3	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
M4	Missing Person(s)	**Pleasure**	Pleasure	**Canoe**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M1	On Fire	**Fishing**	Crab Fishing	**Fishing Vessel**	Rescue
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M4	Other	**Pleasure**	None/Not Applicable	**Canoe**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A1	Crash	**Air**	Unknown	**Single Engine Aircraft**	Rescue
M4	False Alarm	**Pleasure**	None/Not Applicable	**Motor Craft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M2	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Communication
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation

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A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A2	Airborne Emergenc y	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
A2	Airborne Emergenc y	**Air**	Air (Government/Militar y)	**Multi-Engine Aircraft**	Monitoring
A3	Airborne Emergenc y	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
H1	Suicide Attempt	**Other**	None/Not Applicable	**Suicide or Attempt**	Rescue
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
H4	False Alarm	**Other**	None/Not Applicable	**Assist Police**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Other
M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Communicatio n
M4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Resupply
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed

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4. NUNAVIK REGION

Summary: Since 2006, there have been 188 marine SAR cases in the Nunavik region, which includes the waters of James Bay, Hudson Strait and Ungava Bay. There have also been 323 Aeronautical SAR cases in this time period; with most cases occurring in inland regions, and very few on or near Arctic waters. The number of aeronautical SAR cases is also skewed due to 230 A4/A5 cases occurring during this time period, which are considered false alarms.

Examining the risk assessment heat map for the region, the maritime RAMSARD risk assessment for the pleasure crafts in the region is generally on the higher end of low, with some medium risks attributed to inland aircraft SAR cases and commercial vessels. Although some fishing vessel activity has been reported, SAR cases within this category are very infrequent with a low impact.

Impact		Rare	Unlikely	Moderate	Likely	Almost Certain
	Extreme					
	High		Small Aircraft (A1)	Large Aircraft (A1-A3)		
	Moderate		Small Aircraft (A2,A3)			
	Low		Pleasure Craft 9M2) Fishing Vessel (M1, M2) Commercial Vessel (M1-M3)	Pleasure Craft (M1, M3) Fishing Vessel (M3)		
	Negligible					
		Likelihood				

Location-Specific SAR Statistical Support

Map of SAR Cases 2006-2016:

Figure 17. Map of SAR Cases 2006-2016.

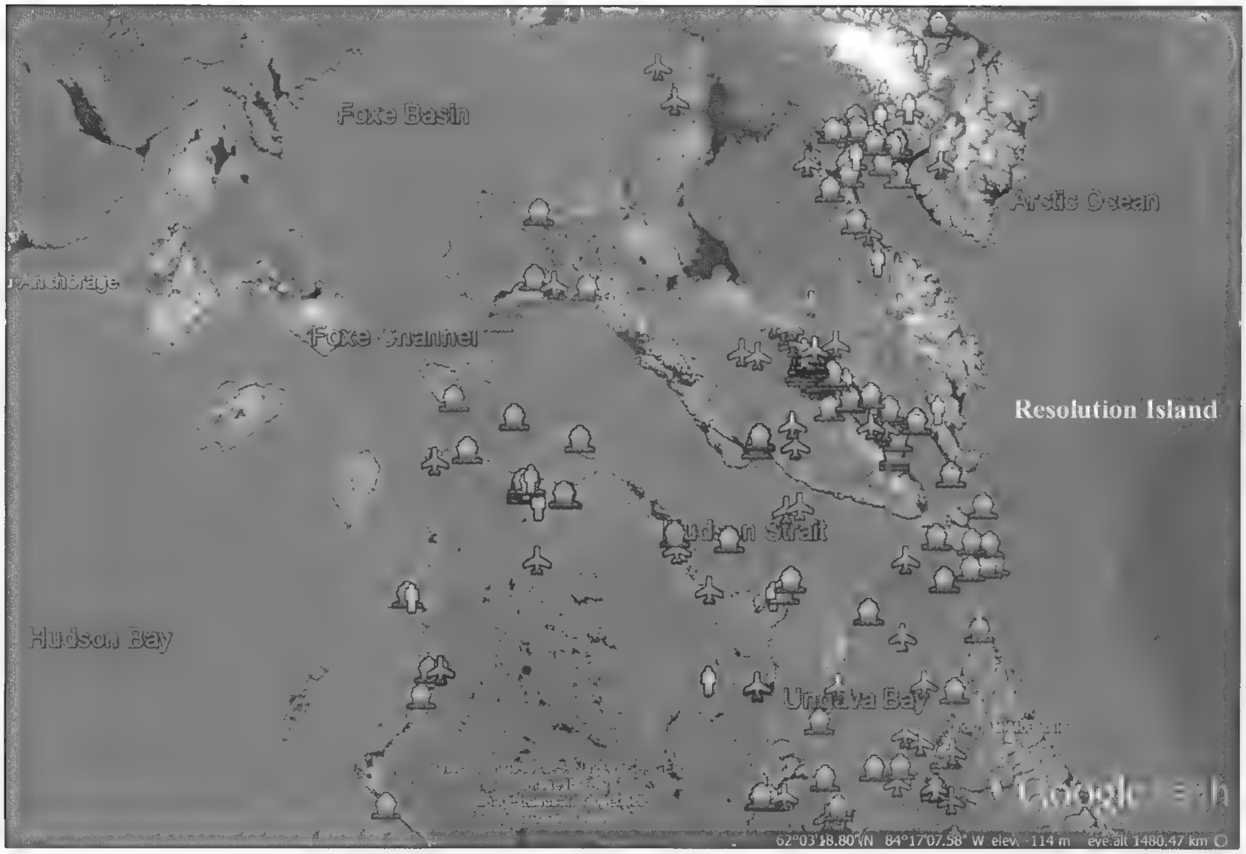
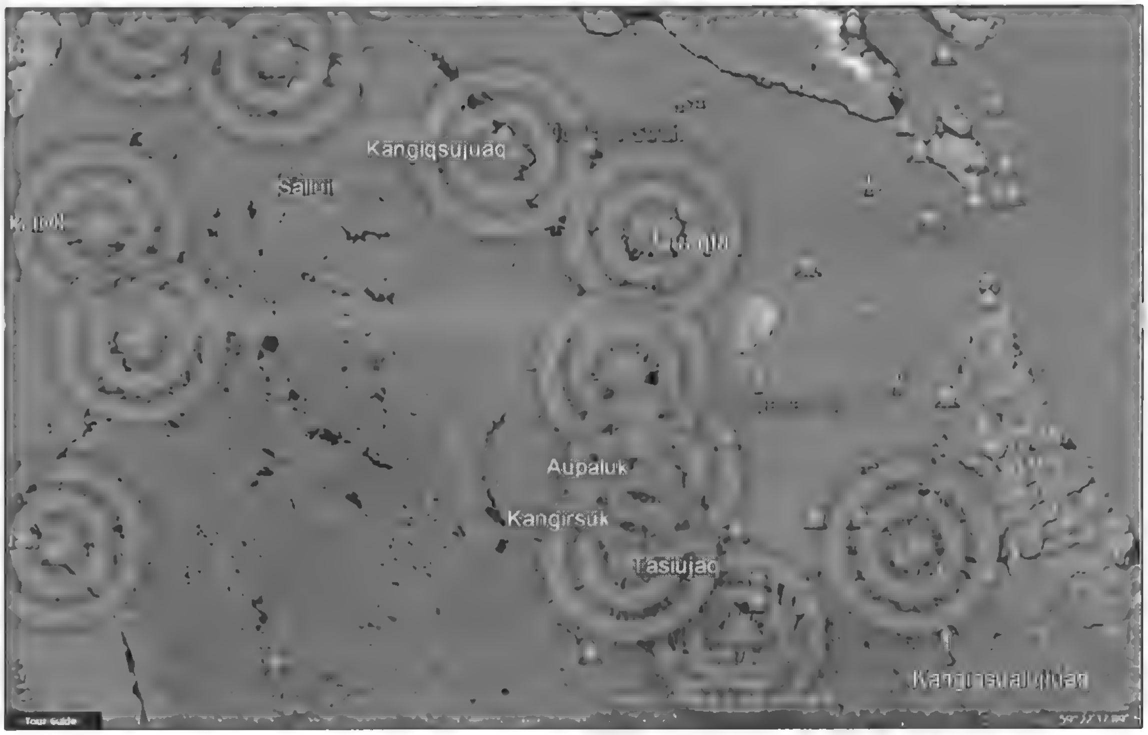
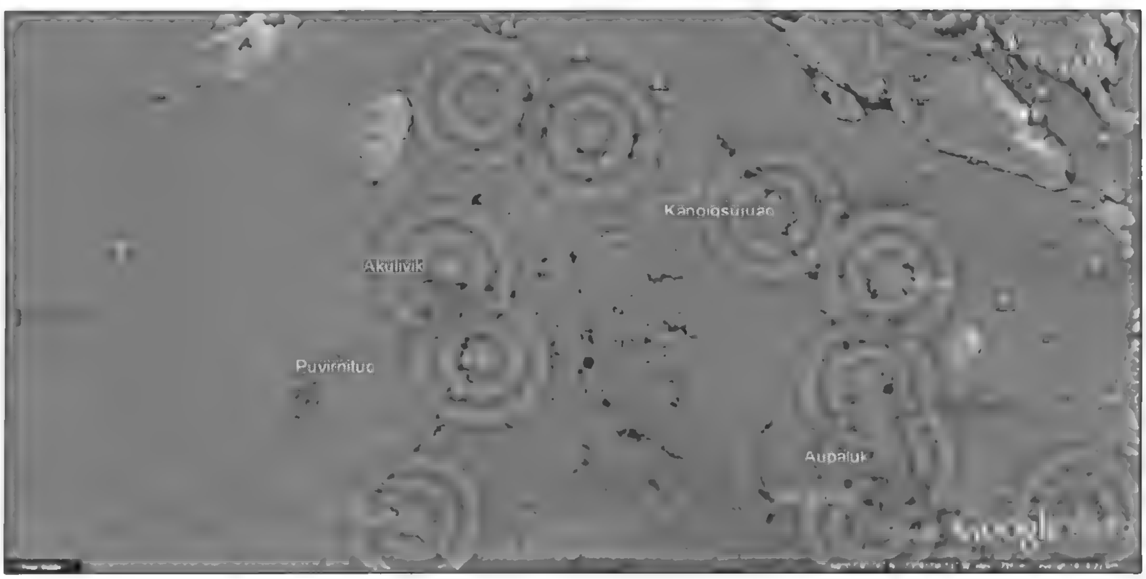


Figure 18. Map of SAR Cases 2006-2016 and areas of increased SAR concentration.

Examining the historical SAR case data from the Hudson Strait and Ungava Bay, a number of cases appear in the Foxe Channel as well as around the southeastern tip of Resolution Island. There is also a small concentration of cases between Kuujjuaq and Kangiqsualujjuaq. Those cases in Foxe Channel may be serviced from an asset located in Cape Dorset, while those at Resolution Island are at least 120nm from the nearest sizable community, and would represent a response challenge.

Current SAR response in the Nunavik region is offered through 14 community vessels which were provided to the communities under funding received from the *James Bay Northern Quebec Agreement*. These vessels are managed by the Kativik Regional Government and are enclosed 30' vessels with twin 200HP+ engines. The SAR coverage radius of these units is depicted below overlain on existing SAR cases from 2006-2016.


Kangiqsujuaq
Salluit
Aupaluk
Kangirsuk
Tasiujaq


Kangiqsujuaq
Akulivik
Puvirnituq
Aupaluk

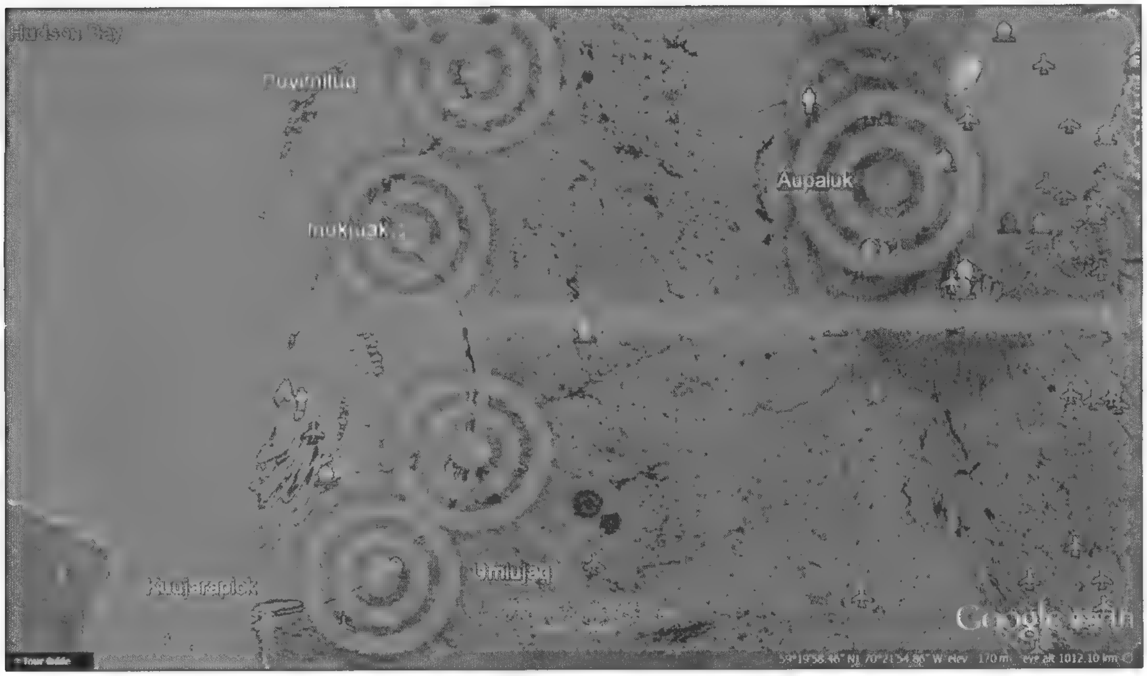


Figure 19. SAR asset response range for existing Kativik Regional Government vessels.

Ice Conditions

Examining the historical ice conditions around the region, it appears that the ice conditions in the region vary considerably between years and in different areas of the region. Examining historical records, some years have significant regions of ice-free waters on July 1st, while others do not have open water until much later into the summer. In each year examined, there were ice-free waters that extended throughout the region into early October.

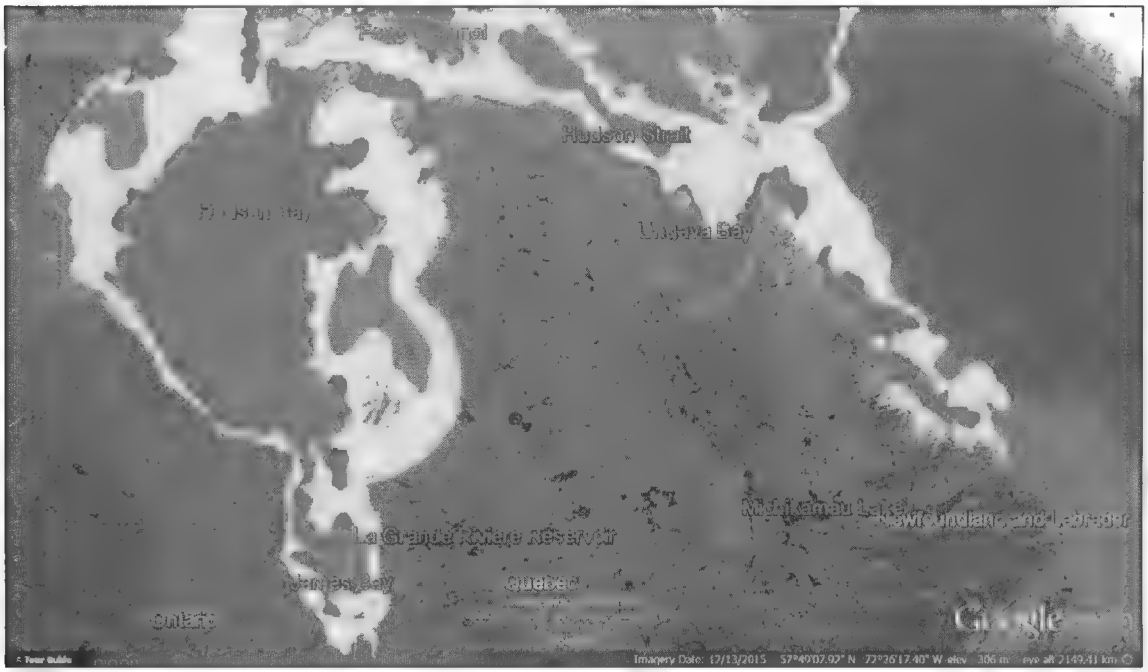


Figure 20. Representation of the more severe ice conditions seen at the beginning of the season, as seen on July 1, 2013.

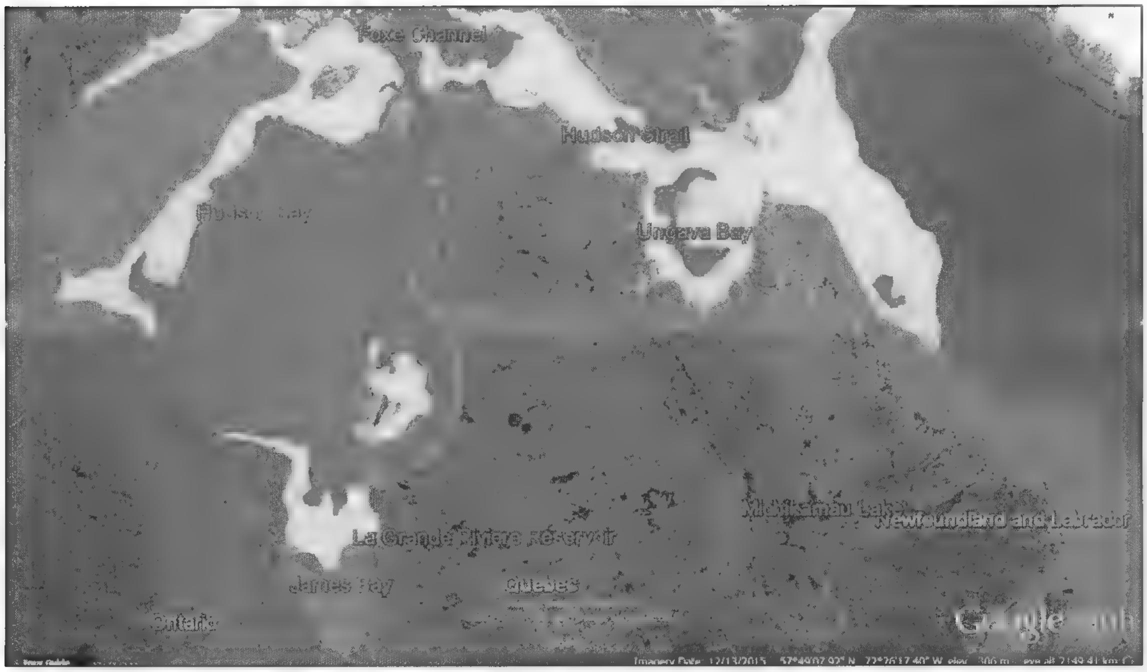


Figure 21. Representation of the more severe ice conditions seen at the beginning of the season, as seen on July 1, 2015.

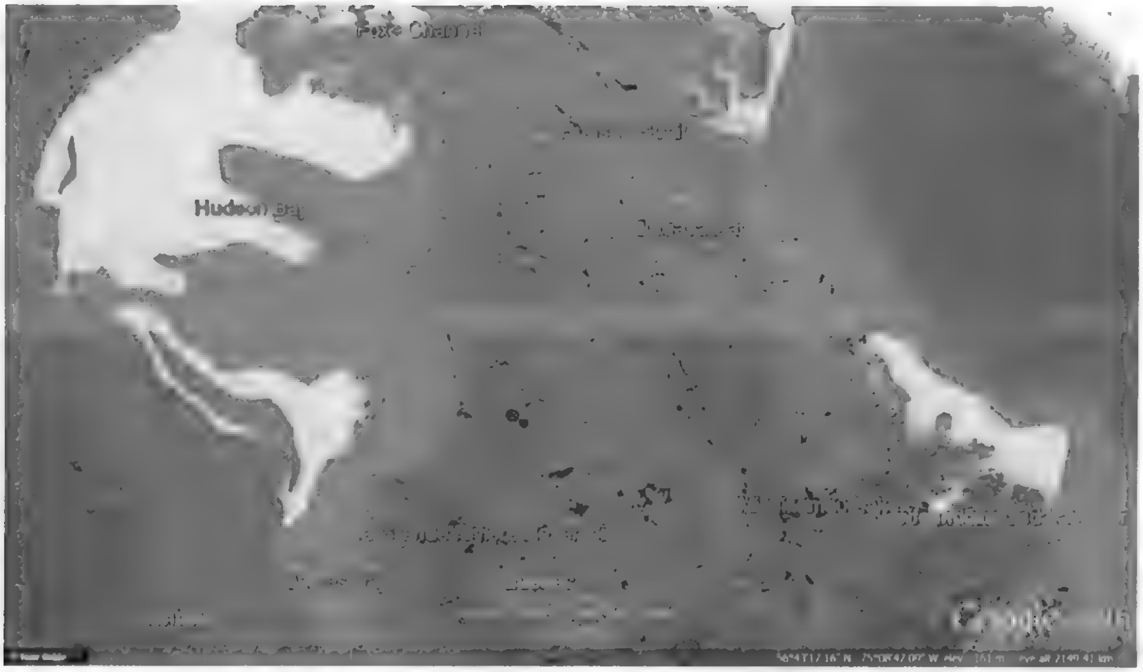


Figure 22. Representation of the less severe ice conditions seen at the beginning of the season, as seen on July 1, 2010.

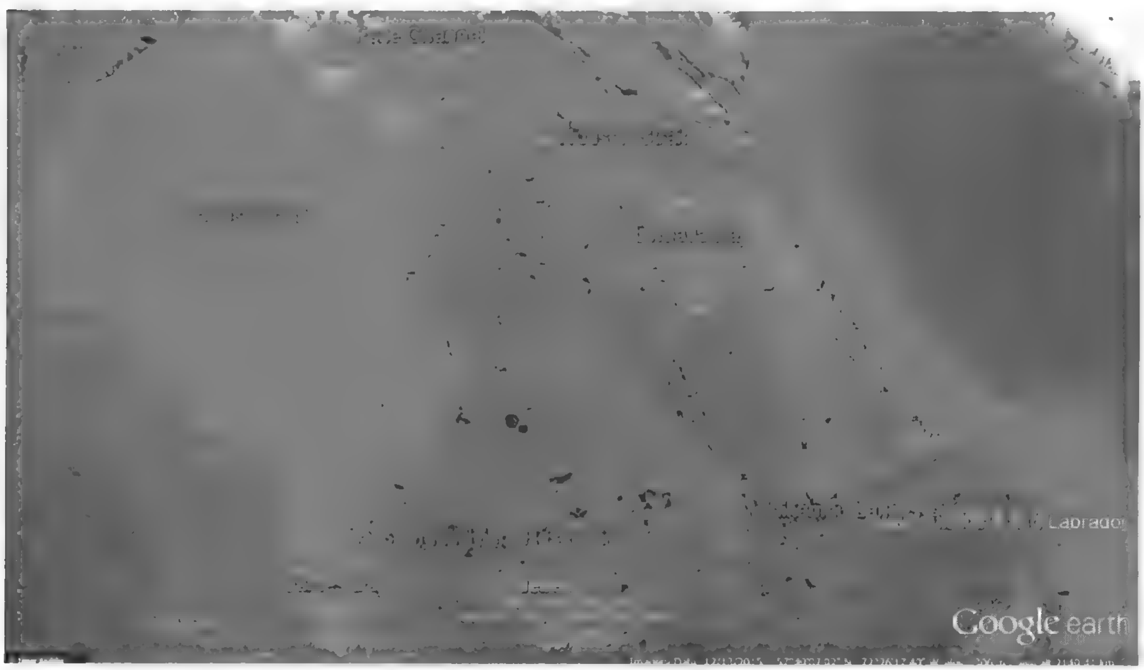


Figure 23. Representation of the end-of-season ice conditions, as seen on October 15, 2010.

Comprehensive SAR Risk Estimation

Impact	Rare	Unlikely	Moderate	Likely	Almost Certain
Extreme					
High		17	21,22,23		
Moderate		18,19			
Low		2,5,6,9,10,11	1,3,7		
Negligible					
	Likelihood				

Note: The RAMSARD process is not a relative risk tool, and should not be used to compare area risks to other area risks or to the national risk matrix. Each area has unique risks and may have unique resources to cover those risks. During consultations with stakeholders, the national risk matrix will be shown only to indicate that it is complete and to show that local figures are used in the Analysis (as opposed to the national figures being applied to local area assessments).

CATEGORY			
1	M1 - Pleasure Craft	**15**	M3 - Major Ferry - Oil Rig
2	M2 - Pleasure Craft	**16**	M4 -Major Ferry - Oil Rig
3	M3 - Pleasure Craft	**17**	A1 - Small Aircraft
4	M4 - Pleasure Craft	**18**	A2 - Small Aircraft
5	M1 - Fishing Vessel	**19**	A3 - Small Aircraft
6	M2 - Fishing Vessel	**20**	A4 - Small Aircraft
7	M3 - Fishing Vessel	**21**	A1 - Large Aircraft
8	M4 - Fishing Vessel	**22**	A2 - Large Aircraft
9	M1 - Commercial Vessel	**23**	A3 - Large Aircraft
10	M2 - Commercial Vessel	**24**	A4 - Large Aircraft
11	M3 - Commercial Vessel	**25**	H1 - Humanitarian
12	M4 - Commercial Vessel	**26**	H2 - Humanitarian
13	M1 - Major Ferry - Oil Rig	**27**	H3 - Humanitarian
14	M2 - Major Ferry - Oil Rig	**28**	H4 - Humanitarian

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This Risk Assessment is based on the parameters:

Table 1 – Impact

Impact	
Extreme	More than 50 lives lost in incident.
High	More than 10 lives lost in incident.
Moderate	More than 5 lives lost in incident.
Low	One to five lives lost in incident.
Negligible	No lives lost in incident.

If the data is absent, all reviewers will be required to use the following assumptions for determining consequences:

- A pleasure craft has four persons on board;
- A fishing vessel has five persons on board;
- A commercial vessel has twenty persons on board;
- A cruise ship, ferry or oil rig has more than fifty persons on board;
- A small aircraft carries ten or fewer persons; and
- A large aircraft carries more than ten persons.

Table 2 – Likelihood

Likelihood	
Almost Certain	1 incident or more per week
Likely	1 or more incident per month
Moderate	1 or more incident per year
Unlikely	1 incident every 10 years
Rare	1 incident every 25 years or more

ANNEX: Nunavik Region Expanded Regional SAR Case Profile: 2006 – 2016.

Air – 323; Marine – 188; Humanitarian – 54; Unknown – 28

Year	Final Classification	Incident Type	Craft Category	Craft Sub-Category	Craft Type	Action Taken
2006	M4	False Alarm	Fishing	Commercial Fishing Other	Fishing Vessel	Investigation
	H1	Stranded	Other	Pleasure	Person	Rescue
	A4	False Alarm	Other	Unknown	Unknown	Investigation
	U4	False Alarm	Other	Unknown	Unknown	Investigation
	A3	Airborne Emergency	Air	Air (Government/Military)	Multi-Engine Aircraft	Monitoring
	A4	False Alarm	Air	Unknown	Multi-Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A1	Crash	Air	Unknown	Single Engine Aircraft	Recovery
	U4	False Alarm	(blank)	(blank)	(blank)	Investigation
	M4	False Alarm	Fishing	Commercial Fishing Other	Fishing Vessel	Investigation
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation
	A3	Forced Landing	Air	Unknown	Single Engine Aircraft	Investigation
	A3	Other	Air	Unknown	Single Engine Aircraft	Search
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Government/Military)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Search
	A4	False Alarm	Air	Unknown	Multi-Engine Aircraft	Investigation
	M2	Medical	Government	Government	Government Vessel	Evacuation
	A1	Crash	Air	Unknown	Single Engine Aircraft	Rescue
	A1P	Forced Landing	Air	Air (Commercial)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Homing
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Homing
	H1	Medical	Other	Unknown	Evacuation	Evacuation
	M4	False Alarm	Pleasure	Pleasure	Sail Craft	Investigation

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	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1P	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	None
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
	M2	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Evacuation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Other	**Air**	Unknown	**Multi-Engine Aircraft**	Investigation
	A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	U4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Fishing**	Ground Fishing	**Fishing Vessel**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M1	Other	**Commercial**	Marine Transportation	**Bulk Carrier**	Rescue
	M1	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Search
2007	**U4**	Other	**Other**	Unknown	**Unknown**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
	M3	Medical	**Pleasure**	Marine Transportation	**Motor Craft**	Technical Assistance
	H1	Missing Person(s)	**Pleasure**	Pleasure	**Motor Craft**	Investigation
	A5	Airborne Emergency	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Airborne Emergency	**(blank)**	(blank)	**(blank)**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Cargo Ship**	Communication
	M3	Grounded	**Commercial**	Marine Transportation	**Tug**	Monitoring
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Homing
	M2	Disabled	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Monitoring
	M3	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Escort
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Towed

	M2	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Communication
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M5	False Alarm	**Fishing**	Unknown	**Fishing Vessel**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Homing
	M5	Grounded	**Commercial**	Unknown	**Ferry Boat**	Investigation
	M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	M1P	Capsized	**Commercial**	Marine Transportation	**Tug**	None
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**Other**	Unknown	**Nil**	Investigation
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	H4	False Alarm	**Other**	None/Not Applicable	**Other**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Resupply
	M5	Other	**(blank)**	(blank)	**(blank)**	Communication
	M4	False Alarm	**Commercial**	None/Not Applicable	**Tug**	Investigation
	M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Homing
2008	**A3**	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A3	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M2	Capsized	**Pleasure**	Pleasure	**Sail Craft**	Rescue
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	H2	Stranded	**Other**	None/Not Applicable	**Evacuation**	Evacuation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M5	Other	**Fishing**	Unknown	**Fishing Vessel**	Investigation

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	A5	Other	Other	None/Not Applicable	Nil	Investigation
	H2	Person in Water	Other	None/Not Applicable	Other	Rescue
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Homing
	A3	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	Monitoring
	A4	Other	Other	Air (Commercial)	Unknown	Investigation
	A5	Other	Other	Unknown	Unknown	Investigation
	M5	Other	(blank)	(blank)	(blank)	Investigation
	M5	Capsized	Fishing	Unknown	Fishing Vessel	Investigation
	A4	Other	Other	Unknown	Nil	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A5	Other	(blank)	(blank)	(blank)	Investigation
	A4	Other	Other	Unknown	Unknown	Investigation
	A1	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Monitoring
	A4	Other	Air	Air (Commercial)	Helicopter	Investigation
	U4	Other	Other	Unknown	Unknown	Investigation
	U4	Other	Other	Unknown	Unknown	Investigation
	A4	False Alarm	Other	Unknown	Unknown	Investigation
	M2	Disabled	Pleasure	Hunting	Canoe	Monitoring
	A4	Other	Other	Unknown	Unknown	Monitoring
	U4	Other	Other	Unknown	Unknown	Investigation
	A3	Airborne Emergency	Air	Air (Private/Pleasure)	Single Engine Aircraft	Monitoring
	A1	Crash	Air	Air (Private/Pleasure)	Multi-Engine Aircraft	Monitoring
	A1	Crash	Air	Air (Commercial)	Single Engine Aircraft	Monitoring
	A1	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Single Engine Aircraft	Investigation
	H1	Missing Person(s)	Other	None/Not Applicable	Missing Person	Search
	A4	False Alarm	Air	Air (Commercial)	Helicopter	Investigation
	A4	False Alarm	Other	Unknown	Unknown	Homing
	H1	Missing Person(s)	Other	None/Not Applicable	Missing Person	Search
2009	H3	Missing Person(s)	Other	None/Not Applicable	Missing Person	Communication
	U4	Other	Other	Unknown	Unknown	Investigation
	H5	False Alarm	(blank)	(blank)	(blank)	Investigation

M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
H3	Medical	**Other**	None/Not Applicable	**Evacuation**	Transport of Person(s)
A5	Other	**Other**	Unknown	**Unknown**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M5	Other	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Escort
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A3	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Technical Assistance
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
H3	Other	**Other**	None/Not Applicable	**Evacuation**	Monitoring
A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Homing
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Homing
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
H3	Stranded	**Other**	None/Not Applicable	**Evacuation**	Evacuation
M3	Disabled	**Fishing**	Ground Fishing	**Fishing Vessel**	Towed
M3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation

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	A4	Other	**Other**	Unknown	**Unknown**	Search
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M5	False Alarm	**Commercial**	Marine Transportation	**Roro/Container**	Investigation
	M3	Disabled	**Commercial**	Marine Transportation	**Bulk Carrier**	Monitoring
	M5	Other	**Other**	Unknown	**Unknown**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed
	A4	Other	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	Other	**Other**	Unknown	**Nil**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Sailboard**	Investigation
	H2	Medical	**Other**	None/Not Applicable	**Medevac**	Monitoring
	M1	Capsized	**Pleasure**	Pleasure	**Kayak**	Rescue
	U4	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Foundered	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
	H3	Stranded	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
	A1P	Crash	**Air**	Air (Commercial)	**Single Engine Aircraft**	None
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Search
	A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	M2	Other	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
	H1	Other	**Other**	None/Not Applicable	**Assist Police**	None
	A5	Other	**(blank)**	(blank)	**(blank)**	None
2010	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Monitoring
	A5	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation

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M5	Other	(blank)	(blank)	(blank)	Investigation
A5	Other	Other	Unknown	Unknown	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
H5	Other	Other	None/Not Applicable	PLB Search	Investigation
A4	False Alarm	Air	Air (Private/Pleasure)	Helicopter	Investigation
M4	False Alarm	Fishing	None/Not Applicable	Fishing Vessel	Investigation
M4	False Alarm	Commercial	Marine Transportation	Ferry Boat	Investigation
U4	False Alarm	Other	Unknown	Unknown	Investigation
A4	False Alarm	Other	Unknown	Unknown	Investigation
A1	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
M5	False Alarm	Commercial	Unknown	Tanker	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
A4	Other	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
A4	Other	Air	Air (Commercial)	Single Engine Aircraft	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
A5	False Alarm	Other	Unknown	Unknown	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
A5	Other	Air	Unknown	Helicopter	Investigation
A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
M4	Disabled	Other	None/Not Applicable	Nil	Investigation
M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
A1	Crash	Air	Air (Commercial)	Single Engine Aircraft	Investigation
H4	Other	Other	None/Not Applicable	PLB Search	Investigation
A4	False Alarm	Air	Air (Commercial)	Single Engine Aircraft	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
A1P	Crash	Air	Air (Commercial)	Helicopter	Investigation
M4	False Alarm	Commercial	Marine Transportation	Tug	Investigation
A4	False Alarm	Air	Air (Private/Pleasure)	Helicopter	Investigation
A5	Other	(blank)	(blank)	(blank)	Investigation
M2	Disabled	Pleasure	Pleasure	Canoe	Search
M3	Other	Pleasure	Pleasure	Canoe	Monitoring
M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
M3	Disabled	Fishing	Shrimp Fishing	Fishing Vessel	Towed

	M4	Other	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Other**	Unknown	**Nil**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M2	Disabled	**Fishing**	Pleasure	**Fishing Vessel**	Investigation
	A2	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H4	Medical	**Other**	None/Not Applicable	**Suicide or Attempt**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	Other	**Other**	Unknown	**Unknown**	Investigation
	M4	False Alarm	**Fishing**	None/Not Applicable	**Fishing Vessel**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Rescue
	A4	Other	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M2	Disabled	**Government**	Government	**Government Vessel**	Monitoring
	H4	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	M1	Person in Water	**Pleasure**	Unknown	**Kayak**	Search
2011	**A5**	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation

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M5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
H1	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Rescue
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
M5	False Alarm	**Commercial**	Marine Transportation	**Cargo Ship**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A2	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Other**	Unknown	**Other**	Investigation
A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
M1	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Evacuation
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
M5	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A1	Crash	**Other**	Air (Private/Pleasure)	**Other**	Investigation
A2	Airborne Emergency	**(blank)**	(blank)	**(blank)**	Monitoring
A4	False Alarm	**Other**	Air (Private/Pleasure)	**Other**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A5	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
M5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False	**Air**	Air (Private/Pleasure)	**Single Engine**	Investigation

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		Alarm			Aircraft	
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	Other	Other	Air (Private/Pleasure)	Other	Investigation
	A4	Other	Air	Unknown	Single Engine Aircraft	Investigation
	A5	Other	(blank)	(blank)	(blank)	Other
	A4	Other	Other	Unknown	Other	Investigation
	A4	False Alarm	Other	Air (Commercial)	Other	Investigation
	A3	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	False Alarm	Other	Unknown	Other	Investigation
	M4	False Alarm	Pleasure	Hunting	Motor Craft	Investigation
	U4	Other	Other	Unknown	Other	Investigation
	A4	Other	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	H2	Medical	Other	None/Not Applicable	Evacuation	Evacuation
	H1	Suicide	Other	None/Not Applicable	Suicide or Attempt	Search
	A1	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A4	Other	Other	Unknown	Nil	Investigation
	H1	Missing Person(s)	Other	None/Not Applicable	Missing Person	Communication
	M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Monitoring
	M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
	A5	False Alarm	(blank)	(blank)	(blank)	Investigation
	U4	Other	Other	Unknown	Unknown	Investigation
	M4	False Alarm	Other	None/Not Applicable	Nil	Search
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
	M3	Disabled	Pleasure	Pleasure	Sail Craft	Towed
	M1P	Capsized	Pleasure	Pleasure	Kayak	Investigation
	H2	Missing Person(s)	Other	None/Not Applicable	Missing Person	Investigation
	A1	Crash	Air	Air (Commercial)	Helicopter	Investigation
	M1	Missing Person(s)	Pleasure	Hunting	Open Boat	Search
2012	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A3	Other	Air	Air (Commercial)	Multi-Engine	Monitoring

					Aircraft	
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Search
	M3	Disabled	**Pleasure**	Pleasure	**Personal Watercraft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Resupply
	M2	Medical	**Other**	Marine Transportation	**Other**	Evacuation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A4	False Alarm	**Air**	Pleasure	**Single Engine Aircraft**	Search
	M4	False Alarm	**Commercial**	Marine Transportation	**Tanker**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	False Alarm	**Pleasure**	Unknown	**Canoe**	Search
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	H4	Missing Person(s)	**(blank)**	(blank)	**(blank)**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Search
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Homing
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	U4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
	M3	Disabled	**Pleasure**	Pleasure	**Personal Watercraft**	Towed
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	M3	Disabled	**Other**	Unknown	**Unknown**	Monitoring

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	M4	False Alarm	**Pleasure**	Hunting	**Open Boat**	Other
	M1	Capsized	**Pleasure**	Hunting	**Canoe**	Monitoring
	A1P	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Evacuation
	M3	Other	**Pleasure**	Hunting	**Open Boat**	Search
	H4	Other	**Pleasure**	Pleasure	**Open Boat**	Monitoring
	M3	Other	**Pleasure**	Pleasure	**Motor Craft**	Technical Assistance
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M4	False Alarm	**Pleasure**	Hunting	**Motor Craft**	Search
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
	M2	Medical	**Commercial**	Marine Transportation	**Tug**	Evacuation
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	A1P	Crash	**Other**	Air (Private/Pleasure)	**Other**	None
	M4	Other	**Other**	Unknown	**Unknown**	Investigation
	M1	Stranded	**Pleasure**	Pleasure	**Kayak**	Rescue
	M1	Capsized	**Pleasure**	Hunting	**Motor Craft**	Rescue
	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Rescue
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
2013	**A2**	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Other**	Air (Government/Military)	**Unknown**	Investigation
	A4	Other	**Other**	Unknown	**Unknown**	Investigation

A4	Other	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
A2	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
H1	Other	**Other**	None/Not Applicable	**Transport Medical**	Transport of Person(s)
A2	Airborne Emergency	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Monitoring
A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
M4	False Alarm	**Commercial**	Unknown	**Tug**	Communication
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A5	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Evacuation
A5	False Alarm	**Other**	Unknown	**Unknown**	Other
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M1P	Capsized	**Pleasure**	Hunting	**Open Boat**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A1P	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Monitoring
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Tanker**	Investigation
A1	Crash	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Investigation

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	M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
	M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Communication
	M3	Disabled	Pleasure	Unknown	Motor Craft	Monitoring
	A3	Other	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	M4	False Alarm	Commercial	Marine Transportation	Bulk Carrier	Investigation
	M1	Medical	Commercial	Marine Transportation	Tanker	Communication
	A3	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	Other
	A4	Other	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	H1	Other	Other	None/Not Applicable	Assist Police	Monitoring
	A4	False Alarm	Air	Air (Government/Military)	Helicopter	Investigation
	M5	False Alarm	Fishing	Commercial Fishing Other	Fishing Vessel	Investigation
	M4	False Alarm	Government	None/Not Applicable	Government Vessel	Investigation
	A4	False Alarm	Air	Unknown	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
	M3	Disabled	Pleasure	Pleasure	Motor Craft	Towed
	A4	False Alarm	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A4	False Alarm	Air	Air (Private/Pleasure)	Helicopter	Investigation
	A4	False Alarm	Air	Air (Commercial)	Multi-Engine Aircraft	Investigation
	A1	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	A2	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	Monitoring
	A3	Crash	Air	Air (Private/Pleasure)	Single Engine Aircraft	Investigation
	H2	Missing Person(s)	Other	None/Not Applicable	Other	Monitoring
	A3	Airborne Emergency	Air	Air (Commercial)	Multi-Engine Aircraft	Monitoring
	M4	False Alarm	Other	None/Not Applicable	Nil	Investigation
2014	H4	Other	(blank)	(blank)	(blank)	Monitoring

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M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
U4	Other	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
M4	False Alarm	**Government**	None/Not Applicable	**Government Vessel**	Investigation
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
A2	Forced Landing	**Air**	Air (Commercial)	**Helicopter**	Monitoring
H3	Other	**Other**	None/Not Applicable	**Assist Police**	Investigation
A3	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Helicopter**	Recovery
H3	Other	**Other**	None/Not Applicable	**Evacuation**	Evacuation
U4	Other	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
M1	Foundered	**Pleasure**	Pleasure	**Motor Craft**	Rescue
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Unknown	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A3	Missing Person(s)	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	Medical	**Other**	None/Not Applicable	**Evacuation**	Investigation
M1	Medical	**Government**	Government	**Government Vessel**	Monitoring
A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M2	Disabled	**Pleasure**	Diving	**Open Boat**	Escort
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Escort
M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Monitoring
M3	Other	**Pleasure**	Pleasure	**Sail Craft**	Monitoring
M2	Taking on	**Pleasure**	Government	**Motor Craft**	Communication

		Water				
	M3	Disabled	**Pleasure**	Unknown	**Open Boat**	Monitoring
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M3	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Monitoring
	A2	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Search
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M3	Disabled	**Pleasure**	Pleasure	**Open Boat**	Towed
	H3	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	H1	Person in Water	**Other**	None/Not Applicable	**Suicide or Attempt**	Rescue
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	Other	**Air**	Air (Commercial)	**Helicopter**	Investigation
	M3	Disabled	**Fishing**	????????	**Fishing Vessel**	Towed
	M3	Disabled	**Fishing**	????????	**Fishing Vessel**	Towed
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	H2	Capsized	**Other**	None/Not Applicable	**Missing Person**	Monitoring
	A1	Crash	**Air**	Unknown	**Single Engine Aircraft**	Investigation
	A1	Crash	**Air**	Hunting	**Helicopter**	Rescue
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	Other	**Air**	None/Not Applicable	**Single Engine Aircraft**	Investigation
	A4	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
2015	**A1**	Forced Landing	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	U4	Other	**Other**	Unknown	**Unknown**	Investigation
	A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
	H1	Person in Water	**Other**	None/Not Applicable	**Missing Person**	Investigation

A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Rescue
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Investigation
M3	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	First Aid
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Towed
A4	False Alarm	**Air**	Air (Government/Military)	**Helicopter**	Investigation
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
A1	Airborne Emergency	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Other
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M2	Disabled	**Government**	Government	**Government Vessel**	Search
A5	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
M2	Disabled	**Pleasure**	Hunting	**Motor Craft**	Rescue
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
H4	False Alarm	**Other**	None/Not Applicable	**Assist Police**	Search
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Multi-Engine Aircraft**	Investigation
H1	Other	**Other**	None/Not Applicable	**PLB Search**	Investigation
A5	Other	**(blank)**	(blank)	**(blank)**	Investigation
A4	Other	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
H4	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M4	False Alarm	**Pleasure**	Unknown	**Open Boat**	Monitoring
H3	Body Recovery	**Other**	None/Not Applicable	**Assist Police**	Recovery

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	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	M1	Disabled	**Pleasure**	Hunting	**Open Boat**	Investigation
	M1	Capsized	**Pleasure**	Pleasure	**Kayak**	Rescue
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A1	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	M4	False Alarm	**Commercial**	Unknown	**Barge**	Search
	M3	Grounded	**Pleasure**	Pleasure	**Sail Craft**	Refloated
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	H5	False Alarm	**(blank)**	(blank)	**(blank)**	Investigation
	A1	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
	M3	Disabled	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Towed
	M3	Grounded	**Fishing**	Commercial Fishing Other	**Fishing Vessel**	Refloated
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Helicopter**	Investigation
	A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	A1	Crash	**Air**	Air (Commercial)	**Helicopter**	Rescue
	A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
	A4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
2016	**H2**	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Investigation
	H1	Medical	**Other**	None/Not Applicable	**Medevac**	Rescue
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Search
	A4	Other	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
	H2	Missing Person(s)	**Other**	None/Not Applicable	**Missing Person**	Other

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A1P	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
H1	Person in Water	**Other**	None/Not Applicable	**Other**	Communication
M3	Disabled	**Fishing**	Crab Fishing	**Fishing Vessel**	Towed
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Search
A1	Crash	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A3	Airborne Emergency	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Monitoring
M3	Medical	**Government**	Government	**Government Vessel**	Monitoring
M3	Medical	**Commercial**	Marine Transportation	**Cargo Ship**	Monitoring
M4	Missing Person(s)	**Pleasure**	Pleasure	**Canoe**	Investigation
A4	False Alarm	**Air**	Air (Government/Military)	**Helicopter**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
M1	On Fire	**Fishing**	Crab Fishing	**Fishing Vessel**	Rescue
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Monitoring
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M4	Other	**Pleasure**	None/Not Applicable	**Canoe**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Single Engine Aircraft**	Investigation
A1	Crash	**Air**	Unknown	**Single Engine Aircraft**	Rescue
M4	False Alarm	**Pleasure**	None/Not Applicable	**Motor Craft**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
A4	False Alarm	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
U4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
A4	False Alarm	**Air**	Air (Private/Pleasure)	**Single Engine Aircraft**	Investigation
M2	Medical	**Fishing**	Shrimp Fishing	**Fishing Vessel**	Investigation
A5	False Alarm	**(blank)**	(blank)	**(blank)**	Communication
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Investigation
A4	False	**Air**	Air (Private/Pleasure)	**Single Engine**	Investigation

	Alarm			**Aircraft**	
A2	Airborne Emergency	**Air**	Air (Private/Pleasure)	**Helicopter**	Investigation
A2	Airborne Emergency	**Air**	Air (Government/Military)	**Multi-Engine Aircraft**	Monitoring
A3	Airborne Emergency	**Air**	Air (Commercial)	**Multi-Engine Aircraft**	Monitoring
H1	Suicide Attempt	**Other**	None/Not Applicable	**Suicide or Attempt**	Rescue
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
H4	False Alarm	**Other**	None/Not Applicable	**Assist Police**	Investigation
U4	Other	**Other**	Unknown	**Unknown**	Other
M4	False Alarm	**Commercial**	Marine Transportation	**Bulk Carrier**	Communication
M4	False Alarm	**Other**	Unknown	**Unknown**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Motor Craft**	Resupply
M4	False Alarm	**Other**	None/Not Applicable	**Nil**	Investigation
M3	Disabled	**Pleasure**	Pleasure	**Sail Craft**	Towed

Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

UNCLASSIFIED
GCCMS # : 20##-###-#####
EKME # : #######

To: / Pour:	Julie Gascon	Date: August XX, 2017

Object: / Objet: **INITIAL RISK-BASED ANALYSIS OF MARITIME SEARCH AND RESCUE DELIVERY – ARCTIC REGION (2017)**

From / De: Steve Thompson, Officer – Arctic SAR

Via: Peter Garapick, Superintendent – Arctic SAR

Via: Harry Chadwick, Regional Director, Incident Management

Additional approvals:
Autre(s) approbation(s):

[ ]	Your Signature / Votre signature	[X]	Information
[ ]	For Comments / Observations	[ ]	Material for the Minister / Documents pour le Ministre

Remarks:
Remarques:

Drafting Officer/ Rédacteur: Steve Thompson (438-993-4622)

Pêches et Océans Canada | Fisheries and Oceans Canada

Garde côtière canadienne | Canadian Coast Guard

SAR RISK ANALYSIS

(Previously known as RAMSARD:
the Risk-based Analysis of the Maritime Search and Rescue Delivery)

Under the Oceans Protection Plan, the Canadian Coast Guard (CCG) implemented a national Search and Rescue Risk Analysis methodology. This methodology has been developed by the Canadian Standards Association. It provides a structured process for identifying, analyzing, evaluating and documenting maritime risks in a consistent manner across the Search and Rescue (SAR) system.

Every five years, the SAR Risk Analysis will analyze the 40 SAR areas across Canada. This analysis will help the CCG perform a systematic analysis to proactively identify the SAR areas with new or emerging maritime risks so that its provision of service is based on current and expected SAR needs. This review process strives to provide the planning tool for the SAR program to improve planning and decision-making for SAR and maritime security. This includes a better understanding of the risks in the maritime environment, the implementation of mitigation measures, and the provision of recommendations to other organizations responsible for requirements for equipment on board and prevention activities.

Stakeholders, clients and partners will participate in the SAR Risk Analysis review process. The SAR Risk Analysis methodology includes various elements to involve and allows stakeholders, clients and partners not only to help to identify risks related to maritime activities in their sectors, but also to validate risk scenarios and mitigation strategies that have been developed. The full participation of stakeholders, clients and partners in the review process and its conclusions is a key component in the project's success.

The national implementation of the SAR Risk Analysis will allow the CCG to benefit from the following:

- Reviewing the efficiency of the delivery of maritime SAR services, encompassing all available resources (including assets of the Canadian Armed Forces, the Canadian Coast Guard Auxiliary, vessels of opportunity, etc.)
- Fostering a government-wide approach to risk mitigation for SAR at sea
- Implementing a mechanism to engagement with stakeholders, clients and partners
- Developing a tool for credible risk-based decisions about service standards
- Creating reliable information to be used for operational planning in the regions
- Improving baselines for performance measurement and data collection to support ongoing analysis
- Improving of the strategic planning and decision-making process

For any questions or additional information, please contact the SAR Risk Analysis Project Manager, Sylvain Labatt, at sylvain.labatt@dfo-mpo.gc.ca.

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Fisheries and Oceans Canada
Canadian Coast Guard

RAMSARD

Risk-based Analysis of the Maritime Search and Rescue Delivery

Originating from the Oceans Protection Plan of the federal government, the Canadian Coast Guard (CCG) implemented nationally its Risk-based Analysis of Maritime Search and Rescue Delivery methodology (RAMSARD).

RAMSARD utilises a risk analysis method from the Canadian Standards Association (CSA). This methodology provides a structured process for identifying, analyzing, evaluating and documenting maritime risks in a consistent manner across the Search and Rescue (SAR) system.

Over a 5 year cycle, RAMSARD will analyse the 40 maritime SAR areas in Canada. In doing so, CCG systematically analyzes its data, so that its provision of service is based on current and expected SAR needs.

RAMSARD will assist the CCG in proactively identifying SAR areas with new or emerging marine risks and ultimately ensure a more systematic approach to evaluating maritime SAR delivery in Canada. This review process is intended to be the SAR program planning tool and once fully implemented will result in improved SAR planning, decision-making and ultimately marine safety. This will allow the Coast Guard to understand marine risks better and then develop mitigation measures that will cover a broad range of options including re-profiling SAR resources, increasing volunteer capacity or recommending changes in safety equipment carriage requirements, regulations and/or prevention efforts.

Stakeholders, clients and partners will be fully engaged in the RAMSARD review process. The RAMSARD methodology has various elements of engagement and allows stakeholders, clients and partners to assist with not only identifying marine risks in their areas but also providing validation of the risk scenarios and mitigation strategies developed. Stakeholders, clients and partners being fully engaged in the review process and its findings should assure their support of the initiative.

Moving forward with national implementation of RAMSARD allows the Coast Guard to benefit from:

- The ongoing review of the effectiveness of maritime SAR delivery, encompassing all available resources (CAF, CCGA, vessels of opportunity etc., not solely focused on Coast Guard assets);
- a whole of government approach to maritime SAR risk mitigation;
- a mechanism for the engagement of stakeholders, partners and clients;
- a tool for credible risk-based decision-making, linked to service standards;
- sound information for use in operational planning within regions;
- Improvements in benchmarks for performance measurement and the collection of data in support of ongoing analysis, and; improved strategic planning and decision-making.

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RAMSARD Project Manager

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Arctic RAMSARD

The CCG Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) methodology was designed to evaluate the risks to mariners in the Search and Rescue Areas (SRA) on federally SAR mandated waters in order to determine where SAR assets could be added, enhanced or withdrawn. Initially, the RAMSARD process was targeted on the SRA's of the Pacific, Great Lakes and St Lawrence River and Gulf and the Atlantic; these are areas where existing CCG/CGA assets are located and/or traditional CCG clients operate. The vast majority of these SRA's are of a consistent size (approximately XX sq nm) where shore-side communities are within a close proximity of each other.

The Arctic RAMSARD study involved the waters of the Arctic Ocean, (from the Beaufort Sea in the west to the Hudson Strait in the east), the Mackenzie Delta and Hudson Bay. This geography is subdivided into 4 SRA's (010, 155, 259 and 260) with a total area of XX square nm, making the SRA's an average of XX sq nm - the biggest being XX sq nm and the smallest being XX sq nm. There are 44 Inuit communities within this area located in Northwest Territories, Nunavut and Nunavik (Northern Quebec) as well as one Inuit, Dene and Cree community of Churchill, Manitoba. The communities are isolated, spread across a vast and harsh maritime environment with usually hundreds of miles between each community. The study did not involve the 10 Cree communities in James Bay on the shores of Ontario and Quebec or the 6 Inuit communities located in Nunatsiavut (Labrador).

The Arctic RAMSARD study was solely focussed on whether CCG Auxiliary SAR Units could be established in the aforementioned communities to increase the local SAR capacity in the Arctic. The study did not consider CCG Lifeboats or Inshore Rescue Boat Stations. Establishment of CGA SAR Units would reduce the reliance on SAR assets such as CCG icebreakers, often situated hours or days away from the location of a SAR incident, and RCAF fixed and rotary wing aircraft, based thousands of miles to the south. A quick response by a local SAR Unit to aid another small vessel from the community in need of assistance would be much more efficient and would also allow CCG icebreakers and RCAF aircraft to be available for other operations where they may be more effective.

The methodology used to collect data and gain knowledge of the waters and communities in the Arctic SRA's involved extensive travel throughout the Arctic to gather data that was a mix of qualitative information obtained through meetings with northerners and quantitative statistics obtained predominantly from SAR and Environmental agencies in the south. The Arctic RAMSARD Travel Team was comprised of members, dependant on Arctic community locations, from CCG C&A and Atlantic Regions (JRCC Trenton and Halifax and the respective SAR Programs), CCG Ottawa National Strategies, CCG Auxiliary members (C&A Inc. and Quebec Inc.), as well as partners from the governments of Nunavut and Nunavik. The RAMSARD Team made 11 trips in the north beginning in December 2015 and travelled via chartered aircraft to the Arctic communities, visiting 2 to 3 communities in a day, several in a week. Community visits permitted the team to meet and build relationships with elected officials, community employees, hunters and trappers, first responders and general citizens. The CCG Auxiliary C&A Inc. was an especially valuable source of information as they have operated 7 SAR Units in Arctic communities (and 2 on Great Slave Lake) for almost 15 years.

Application of RAMSARD in the Arctic

Application of RAMSARD methodology in the south has a keen focus on numbers of mariners in an area and the inherent risk level of their activities, influenced by the prevailing meteorological and maritime conditions. While other factors will determine where SAR units should be located, these are the driving factors in the south. In the Arctic, mariner numbers and activities are low, meteorological and maritime conditions are similar and of high risk throughout the northern waters and response time of SAR assets is long. Due to this scenario, the Arctic environment requires that certain factors be weighted more heavily than in southern locations.

The typical RAMSARD factors used to evaluate risks to mariners include data relative to the socio-economics of the community in question, the type of maritime activities in the area, prevailing meteorological and geographical conditions and available SAR services in the area. Annex A presents the complete list of factors captured within these four categories and the status of those factors for each of the 44 communities. The factors that overwhelmingly play a more important role for RAMSARD in an Arctic community are the level of community enthusiasm and community support for a CGA SAR Unit and the availability of a capable boat or boats to be used for SAR response.

> Community Enthusiasm - Most Arctic communities are small with populations ranging from 150 to 2500, the average population of the 44 communities is 800. Iqaluit is by far the largest centre with a population near 8000 today while other major centres of Kuujjuaq, Rankin Inlet, Arviat and Inuvik have populations near 2500. Finding a group of 15-20 enthusiastic SAR responders in isolated small communities is much more difficult than in southern communities where populations are larger and roads allow CGA members to drive from further away to the response boat location. When a community is able to gather a group of interested SAR responders, that community is rated higher on the RAMSARD scale.

> Community Support – groups, activities and events in an Arctic community must be supported by the citizens and the community council. If the council is supportive of establishing a maritime CGA SAR Unit, and may provide a dedicated SAR office/operations room, storage areas for gear and/or vessel, some funding for costs not covered by CGA Contribution Agreements, then that community was rated higher on the RAMSARD scale.

> Response Boat - the creation of a CG Auxiliary SAR Unit relies on a vessel that is already in the community and most often not designed for a dedicated SAR response. This is a critical factor in determining whether a SAR unit can be established in a community since if a capable vessel is not available, even if potential responders are and a SAR unit has community support, CGA and CCG will not certify an unsafe boat and RCC will not task such a vessel. Therefore, when an Arctic community is able to identify one or more capable vessels for the SAR unit, then that community was rated higher on the RAMSARD scale.

Initial Results – Summer 2016

Following the initial visits to communities, the Arctic RAMSARD Team rated each community on the data collected. Of interest, overall the meteorological and maritime conditions (ice severity, sea state, etc.) were deemed common among all communities and therefore did not play a deciding factor. The impact of ice did play a factor based on the length of the open water season and was determined to be of more importance than number of boats in a community. A short boating season meant the level of activity was lower thus the risks were reduced relative to a community with a longer open-water season. Shoulder-seasons, (spring ice-breakup, fall ice-forming) have higher risks for boaters in all locations regardless of season length.

As expected, the influencing factors were the number of potential CGA members coming forward in a community, the community support and the availability of a vessel to be used for response. Communities that ranked high or medium included, Igloolik, Hall Beach, Iqaluit, Clyde River, Qikiqtarjuaq, Gjoa Haven, Cape Dorset, Kimmirut, Paulatuk, Ulukhaktok and all 14 Nunavik communities since each already had non-CGA dedicated SAR vessels and SAR crews. Sachs Harbour, Grise Fjord, Resolute and Whale Cove were ranked low due to their size, boating activity and/or length of season.

Actual Results – Winter / Spring 2017

In some cases the establishment of new CGA SAR Units in Summer 2017 was surprising as a community that ranked high with enthusiastic potential SAR responders and community support was ultimately unable to identify an available vessel from within the community. In other cases, small communities ranked medium were able to field 20 individuals ready to become CGA members as well as a vessel, with full community (council) support. Clyde River, Igloolik and Hall Beach have not yet been able to establish a CGA SAR Unit due to reasons including inability to motivate enough potential CGA members or navigating the required paperwork or identifying a response vessel. Alternatively, the small communities of Ulukhaktok and Gjoa Haven have been highly successful and are now fully operational.

Another constraint that was identified was the training capacity that the CGA regions of Quebec and C&A Inc. could commit to Arctic courses. The distance and time for travel, available instructors and associated costs were limiting factors in permitting new CGA units to become operational.

The 14 communities in Nunavik presented a great opportunity to have 14 new CGA units in 2017; however, unanticipated combination of challenges in the form of an unintentional controlling role maintained by the Katavik Regional Government regional partner, an inability of the CGA Quebec Inc. to take the necessary actions to counter that regional control as well as CCG not realising the implications of the situation, resulted in only 2 new Nunavik CGA SAR Units, Kuujjuaq and Salluit. CGA Quebec Inc. was very successful in certifying 4 Inuit instructors but they had limited success due to the issues noted above.

Lessons Learned / Best Practices

Since beginning in the late Fall of2015, the Arctic RAMSARD Team has seen great success, not only measured in the number of new CGA SAR units but in the new and positive relationship created with CCG and territorial and regional governments, Arctic agencies, community leaders and Inuit throughout the Arctic. The team's approach has been one of high cultural awareness and respect and transparency at all levels of interaction – individual, community or regional /territorial governments or agencies. Once support has been confirmed from higher levels of government, a grass-roots (community) approach is the best strategy for success of creating new CGS SAR Units.

The CCG has been a respected federal agency in the Arctic and the Arctic RAMSARD Team has been successful because of and built on that reputation. The CGA Model is a proven volunteer SAR program and the Arctic RAMSARD Team has been very successful in presenting it as the way forward for effective community based SAR response in the Arctic.

The CGA Regions of Quebec and C&A have risen to the occasion and have been supportive, flexible, enthusiastic, patient and shown astute cultural awareness in working with their new Inuit members. They have translated materials and attempt to make the necessary changes to their programs where possible to make them successful in the Arctic. Leadership roles are being developed or have been offered to new Inuit members to ensure northern people are managing northern programs.

CGA C&A Inc has proven that a dedicated and supportive administrative position is required to facilitate the establishment and sustainability of CGA Arctic SAR Units. Today's CGA in the south is a result of 40 years of efforts; to ensure 2 years of work in the Arctic is maintained and can flourish, dedicated Arctic positions, perhaps initially located in the south but ultimately located in the North, are imperative.

Without a doubt, the most effective manner to travel to and between Arctic communities is with chartered aircraft. The key is to have the appropriate team membership on each trip, work closely with communities as to the travel schedule and ensure everyone is prepared to change that schedule at the last minute due to weather related issues.

Training is a key component of establishing a new CGA SAR Unit and in the Arctic this consumes a great amount of funds. This message has been received in Ottawa and current available G&C have been redirected to the Quebec and C&A CGA Regions to ensure training in winter 2018 can be carried out.

The OPP Community Boats Project is a complimentary undertaking that reinforces the federal government and the CCG commitment to sustainable and effective SAR service in the Arctic. This has permitted the already strong relationship between the CCG and the Inuit and Arctic governments to become more concrete.

Emerging Issues

Canadian Rangers – CCG Auxiliary

Prior to beginning the Arctic RAMSARD Project, an evaluation was carried out to determine if the Canadian Rangers could play a formal role in building new Arctic CGA Units. It was determined due to the various differences in the two organisations that CCG should focus on a CGA only model and not pursue a formal role with the Ranger organisation. The main difference in that Rangers are paid to respond and CGA members are not was a key issue. Also, the efficient tasking process for a CGA unit that takes minutes by a JRCC compared to the hours or days it can take to muster and task a Ranger unit was a defining issue. Ultimately, the concern that the volunteer CGA model would not attract members when compared with the paid Ranger model was proven false. In fact, every CGA Unit has at least one member who is also a Ranger. Moving forward, CCG and CAF must investigate where common training or exercising can enhance maritime SAR response, in areas such as shoreline searches (from land and water) and communications or in a broader community emergency response.

Arctic MRSC

In just a few years, there is the possibility of having over 45 Inuit CGA SAR units in the Arctic. Based on workload as well as language and culture, an evaluation should be carried out to determine if an MRSC could be established for the Arctic SAR Areas, based in Iqaluit at the MCTS Centre and linked with Emergency Management centres of the regions and territories.

Plans - Phase 2 (2018)

The RAMSARD data and rankings remain current and the lessons learned during the past year and a half have formed the plans for winter – summer 2018. CGA Quebec Region Inc. has followed the lead of C&A Region Inc. and hired an administrator dedicated to Arctic CGA Units. This role in both regions sees administrative support provided to all current and potential community based CGA SAR Units. CGA C&A Inc. Board of Directors have established new volunteer positions specifically for Arctic Training and Operations and Quebec Inc. is following suit.

Discussions with CCG National Strategies have seen G&C Funds made available to the two regions to carry out more training in the Arctic in Winter 2018. Both regions are coordinating their efforts to provide a training "blitz", sharing resources, instructors and aligning courses for new CGA members across the Arctic.

The Artic RAMSARD Team will join forces with the Community Boats Project and revisit communities to both facilitate the establishment of CGA SAR Units and build awareness of and application to the Community Boats process.

In the summer of 2018, CCG C&A Arctic SAR Team is planning to have pairs of exercise officers travel to each new CGA SAR Unit to ensure they stay active in SAR, practice what they have learned and are prepared to respond safely and effectively if and when tasked.

Conclusion

Indubitably, the CCG Auxiliary is the foremost volunteer maritime SAR organisation that will see Arctic communities have the ability to safely and effectively respond to maritime emergencies and safe lives of their neighbours, friends and families who venture out on the waters for hunting and fishing purposes.

The CCG Arctic SAR Team will continue to foster strong and respectful working relationships with Arctic regional and territorial governments and agencies, community councils and individuals and appreciate the incredible commitment of volunteers of the CCG Auxiliaries in order to ensure the National SAR System is effective and efficient on waters on the west, east, Great Lakes and Arctic coasts.

Addendum - IRB North

The Arctic RAMSARD review was initially focussed on CCG Auxiliary SAR Units and not on full-time SAR resources; however, the amassed data and information could be applied to other SAR assets if the question arose. With the announcement of the IRB-North Station OPP Project in November 2016, the data was analyzed and the location of Rankin Inlet was rated as the most effective location in which to establish the IRB Unit.

As indicated above, the challenge of motivating enough volunteer SAR responders and the availability of a capable SAR vessel for a CGA SAR Unit was not at issue – an IRB unit will have a dedicated SAR vessel and highly trained crew. As in a typical southern location risk-based assessment, the key factors were numbers of mariners and level of boating activity. Unlike most Arctic communities, Rankin Inlet is in close proximity to other communities, in fact three fall within 100nm - Chesterfield Inlet is 30nm to the north, Whale Cove is 30 nm to the south and Arviat is another 70nm beyond. Mariners from these communities could receive services from an IRB stationed in Rankin Inlet and in fact, they often transit between these communities.

Community Support remained an important factor for the IRB-North station location but another related concern was the social stability of the community in which to place the young Inuit crew members – was the community a safe community? Rankin Inlet ranked high on this issue while Cape Dorset, another community considered for the IRB Station location list ranked very low. Additionally, the Rankin Inlet location was also supported by Government of Nunavut, Emergency Management Office.

Lastly, Cambridge Bay in the Coronation Gulf and the two neighbouring communities of Igloolik and Hall Beach in the Foxe Basin were high on the list but these communities either already have an effective CGA SAR Unit or are expected to have successful CGA Units in 2018. Rankin Inlet's CGA Unit has not been operational for 2 seasons.

Based on a standard RAMSARD evaluation, Ranking Inlet is the number one location for an IRB-North station.

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Safety First, Service Always

Arctic RAMSARD Study Update

Canadian Coast Guard

Central and Arctic Region

January 19, 2018

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Canada

Table of Content

Executive Summary

The Canadian Coast Guard Auxiliary is the foremost volunteer maritime Search and Rescue (SAR) organization. It enables Arctic communities to develop the ability to safely and effectively respond to maritime emergencies and save the lives of friends, neighbours, and families venturing out on the waters for hunting and fishing purposes.

To foster the creation of auxiliary units across the Arctic, the Coast Guard Central and Arctic Region launched a Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) study in 2015. This study was designed to systematically evaluate risks to mariners in Search and Rescue Areas (SRA) and determine where assets could be added, enhanced or withdrawn. Since the project's inception in fall of 2015, the Arctic RAMSARD Team has observed great success not only measured in the number of new auxiliary units, but in the new and positive relationships created between the Coast Guard and several Arctic stakeholders.

The RAMSARD methodology, partially described herein, is deep-seated in Canadian Standards Association (CSA) guidelines, specifically CAN/CSA-Q850, which describes a process for acquiring, analyzing, evaluating, and communicating information necessary for decision-making. However, as noted by methodology designers, the aeronautical and maritime SAR system differs from many risk analysis and decision-making situations for which CSA Q850 was intended. This combined with the need for a standardized methodology across the organization has resulted in challenges with the development of a template to be used to report on RAMSARD studies.

In the absence of an official reporting template, this paper presents: chief considerations with respect to the application of the methodology in the Arctic; initial and actual results of consultations and data collection; lessons learned and identified best practices; next steps; and finally, associated emerging issues as well as recommendations moving forward. **Appendix B** presents the detailed analysis per community, including each community's ranking for each of the factors retained for this study.

Background

The Coast Guard RAMSARD methodology was designed to evaluate risks to mariners in Search and Rescue Areas (SRA) on Coast Guard mandated waters to determine where SAR assets could be added, enhanced or withdrawn. Initially, the process was targeted in the Pacific, Great Lakes, St. Lawrence River and Gulf and the Atlantic areas, where existing assets are located and/or traditional Coast Guard clients operate.

The Arctic RAMSARD study involved the waters of the Arctic Ocean, from the Beaufort Sea in the west to the Hudson Strait in the east, as well as the Mackenzie Delta and the Hudson Bay. This geography is subdivided into 4 SRA's (010, 155, 259 and 260) with a total area of 2,200,100 square nm, making the SRA's an average of 550,025 square nm – the biggest being 996,600 square nm and the smallest being 139,700 square nm. **Appendix A** provides a list and a map of these areas.

The study focussed on the 45 Inuit communities within these areas. Of note, the community of Baker Lake in Nunavut is not located in Coast Guard mandated waters. This brings the number of communities eligible for an auxiliary unit down to 44. It excluded the 10 Cree communities in James Bay on the shores of Ontario and Quebec and the 6 Inuit communities located in Nunatsiavut (Labrador). **Appendix B** provides a map of communities by Inuit Settlement Area. The study also solely focused on whether auxiliary units could be established and did not examine the establishment of Coast Guard Lifeboats or Inshore Rescue Boat Stations.

Arctic communities are isolated with hundreds of miles between them and spread across a vast and harsh maritime environment. The local presence of capable auxiliary units would allow a timely and effective response to the majority of maritime emergencies in the area, which mostly involve small vessels from the community. This would reduce reliance on other assets such as icebreakers and Royal Canadian Air Force (RCAF) aircraft, often situated hours or days away from the location of an incident, and make them more available for other operations where they may be more effective.

The methodology used to collect data and gain knowledge of the waters and communities in the Arctic involved extensive travel to gather a mix of qualitative information obtained through meetings with Northerners as well as quantitative statistics obtained predominantly from SAR and environmental agencies in the south.

The Arctic RAMSARD Team was comprised of members from Coast Guard Central and Arctic and Atlantic Regions, National Strategies, Coast Guard Auxiliary members (Central & Arctic Inc. and Quebec Inc.), as well as partners from the governments of Nunavut and Nunavik. Beginning in December 2015, the team made 14 trips to the north and travelled via chartered aircraft to Arctic communities, often visiting two to three communities a day. Visits permitted the team to meet and build relationships with elected officials, community employees, hunters and trappers, first responders and citizens. Coast Guard Auxiliary C&A Inc. was an especially valuable source of information as they have operated 9 units in the Arctic for almost 15 years.

Traditional application of the RAMSARD methodology in the south focusses on assessing risk levels across a number of factors in order to then determine the most strategic location to place a SAR asset or prioritize the development of an auxiliary unit. Typical RAMSARD factors relate to the type and level of maritime activities; prevailing meteorological and geographical conditions; and, existing SAR services in the area.

In the North, however, several traditional RAMSARD factors revealed similar findings across communities and therefore did not assist Coast Guard in prioritizing the development of units. Most communities have low boating activity in comparison to the south and pose a high risk in terms of meteorological and geographical conditions. Most communities are isolated and do not have any existing SAR services in the area. As the objective was to establish volunteer SAR units – not to establish full-time Coast Guard resources – it was imperative to find volunteers and obtain the support of the broader community. Therefore, social factors such as community support and enthusiasm, the availability of infrastructure and services as well as the availability of capable SAR vessels, were also retained for this study.

Contrarily to most traditional factors, social factors, infrastructure and availability of services and capable vessels overwhelmingly play a more important role for RAMSARD in the North. They point to a community's propensity to develop an auxiliary unit and assist Coast Guard in prioritizing the development of auxiliary units. These factors are further described below.

Community Support and Enthusiasm

Finding a group of 15 to 20 enthusiastic responders in small isolated communities is much more difficult than in southern areas. Community groups, activities and events must also be supported by the community council. Council can offer support by possibly providing a dedicated office and operations room, storage areas for gear and/or vessels and funding for costs not covered by CGA Contribution Agreements.

When a community was able to gather a group of interested responders and the community council was supportive, that community ranked higher on its propensity to develop a unit.

Infrastructure and Availability of Services

The availability of airstrips or runways, of piers or wharfs, and the availability of medical and mechanical support are essential in supporting SAR operations; from resupplying the auxiliary unit and repairing damaged vessels to caring for and evacuating survivors. Communities deemed to have a sufficient level of infrastructure and services to support an auxiliary unit operations ranked higher on their propensity to develop a unit.

Availability of Capable Vessels

Even with sufficient levels of community support, infrastructure and available services, the Coast Guard will not certify an unsafe vessel and a Rescue Coordination Centre (RCC) will not task an unsafe vessel.

When a community was deemed to have identified one or more capable vessels of adequate size and condition, that community ranked higher on its propensity to develop a unit.

Following initial visits in 2015, each community was ranked on the data collected for each factor retained for the study. **Appendix B** presents the detailed analysis per community; including the rankings it received for traditional RAMSARD risk factors as well as factors regarding its propensity to develop an auxiliary unit.

Overall, meteorological and maritime conditions (ice severity, sea state, etc.) were deemed common among all communities and therefore did not play a deciding factor. Shoulder-seasons (spring ice-breakup, fall ice-forming) have higher risks for mariners in all locations regardless of season length.

However, the length of the open water season was determined to be of higher importance than vessel activity. A short boating season means the level of activity is lower and risks are reduced in comparison to a community with a longer open-water season. As expected, most influencing factors were the levels of community enthusiasm and support as well as the level of infrastructure and availability of services and capable vessels to be used for response.

Communities with **higher rankings** in terms of their propensity to develop a unit:

- Igloolik
- Hall Beach
- Iqaluit
- Clyde River
- Qikiqtarjuaq
- Cape Dorset
- Kimmirut
- Paulatuk
- All Nunavik communities (14 have non-auxiliary dedicated SAR vessel and crew)

Communities with **lower rankings** in terms of their propensity to develop a unit:

- Sachs Harbour
- Grise Fjord
- Resolute
- Whale Cove
- Ulukhaktok
- Gjoa Haven

Current Results (Summer 2017)

Summer 2017 was an opportunity to revisit and validate initial rankings and to complete the full assessment of each community. **Appendix B** presents the most recent analysis conducted per community, including the ranking received for each factor.

Summer 2017 also yielded interesting results in terms of the auxiliary units that have become operational.

The following communities initially received higher rankings in terms of their propensity to develop an auxiliary unit but were unable to establish units:

- Igloolik
- Hall Beach
- Clyde River

Conversely, smaller communities that initially received lower rankings in terms of their propensity to develop an auxiliary unit were able to field 20 individuals ready to become auxiliary members as well as a capable vessel and obtained full community (council) support. The following communities have been highly successful and are now fully operational:

- Ulukhaktok
- Gjoa Haven

The availability of non-CGA dedicated SAR vessels and crews in all Nunavik communities presented a great opportunity to have 14 new units in 2017. However, unanticipated challenges with respect to the definition of roles and communications between the Katavik Regional Government (KRG) and CGA Quebec Inc. resulted in the creation of units only in the following two communities:

- Kuujjuaq
- Salluit

Approach with Communities

Since project inception, the Arctic RAMSARD Team has seen great success, not only measured in the number of new units but in the new and positive relationships created between Coast Guard and territorial and regional governments, Arctic agencies, community leaders and Inuit throughout the Arctic.

The team's approach has been one of high cultural awareness, and respect and transparency at all levels, including individuals, communities and regional or territorial governments or agencies. Once support is confirmed from higher levels of government, a grass-roots community approach has been found to be the most effective strategy for achieving success in the creation of new units.

Coast Guard has been a respected federal agency in the Arctic and the RAMSARD Team was successful because of this reputation. The auxiliary model is a proven volunteer program and the Arctic RAMSARD Team has been very successful in presenting it as the way forward for effective community based SAR response in the Arctic.

The auxiliary regions of Quebec and Central and Arctic have also risen to the occasion and have been supportive, flexible, enthusiastic, patient and shown astute cultural awareness in working with their new Inuit members. They have translated materials and have begun to make the necessary changes to their programs to make them successful in the Arctic.

The most effective manner to travel to and between Arctic communities have been found to be via chartered aircraft. Having the appropriate team members on each trip to work closely with communities was found to be a key element of success. Flexibility with respect to travel schedules due to weather-related issues was also deemed crucial.

Inuit Leadership

Today's CGA in the south is the result of 40 years of efforts and leadership within the auxiliary community. To ensure efforts in the Arctic are maintained, dedicated Arctic positions eventually located in the North and occupied by Inuit are imperative. Leadership roles have been offered to new Inuit members or are being developed to ensure northern people are managing northern programs.

A dedicated and supportive administrative position is also required to facilitate the establishment and sustainability of units. CGA Quebec Region Inc. has followed the lead of C&A Region Inc. and hired an administrator dedicated to Arctic CGA Units. This role in both regions sees administrative support provided to all current and potential community based CGA SAR Units. CGA C&A Inc. and Quebec Inc. Board of Directors have established new volunteer positions specifically for Arctic Training and Operations.

Training

Training was found to be a significant constraint for the auxiliary regions of Quebec and Central and Arctic. Distance, travel time, availability of instructors and associated costs were limiting factors in permitting new units to become operational. While CGA Quebec Inc. was very successful in certifying 4 Inuit instructors, they experienced limited success due to the issues noted above.

This message has been received by NHQ and discussions with National Strategies have seen funds made available to both regions in order to carry out increased training in the Arctic in winter of 2018. Both auxiliary regions are also coordinating efforts to provide a training blitz, share resources and instructors as well as to align courses for new auxiliary members across the Arctic.

Next Steps in 2018

Current RAMSARD results and lessons learned have formed plans for 2018.

Governance and communication issues between KRG and Coast Guard Auxiliary Quebec Inc. have been resolved, which will enable a more dynamic and flexible approach in expanding membership and developing units in the remaining 12 Nunavik communities.

The Central and Arctic SAR Arctic Team plans for exercise officers to visit each new unit to ensure they remain actively engaged and are prepared to respond safely and effectively when tasked. The expertise and leadership of existing units in northern Quebec and Central and Arctic regions will continue to be leveraged.

The Arctic RAMSARD Team will collaborate with the Community Boats Project–a complimentary OPP undertaking that reinforces the commitment to sustainable and effective SAR service in the Arctic–and revisit communities to facilitate the establishment of units and build awareness of the community boat application process.

Through these initiatives, Arctic teams will continue to build on existing relationships with regional and territorial governments and agencies, community councils and individuals to ensure the National SAR System is effective and efficient from coast to coast to coast.

The number of auxiliary units in the Arctic is expected to increase in 2018 as a result of work being conducted through the above initiatives. Supported by evidence from this study to prioritize implementation, many Inuit / Inuvialuit communities are expected to have units by spring 2020.

Finally, with respect to the implementation of a standardized RAMSARD methodology within the Coast Guard, additional NHQ resources and formal training provided to all SAR superintendents in 2018 are expected to yield positive outcomes. Such training and resources will further refine processes and ideally establish official reporting templates to be used in documenting and communicating future RAMSARD updates.

Arctic Coast Guard Auxiliary Chapter

The Arctic's challenges will always be different. It cannot be governed in the same manner as southern Canada. Northern training requirements will also be unique. However, they should be standardized across the Arctic, regardless of Coast Guard regional boundaries and auxiliary regional boundaries. A "made in the Arctic" solution is the way forward to ensure a sustainable and capable volunteer SAR organization. Over the long term, a true Arctic Coast Guard Auxiliary Chapter will be required. It may also become necessary to consider purchasing SAR vessels for communities unable to identify local resources. In that case, it is recommended that purchased vessels be of the same class for ease of repairs and transferability. These could eventually be turned over to the Arctic chapter as part of their asset base.

Canadian Rangers and Coast Guard Auxiliary

Prior to beginning the study, an evaluation was undertaken to determine if the Canadian Rangers could play a formal role in building new Arctic auxiliary units. Due to a number of differences between organizations, it was determined that Coast Guard should focus on an auxiliary model. Ultimately, concerns that the volunteer CGA model would not attract members when compared with the paid Ranger model were proven false. In fact, every auxiliary unit has at least one member who is also a Ranger.

Moving forward, it is recommended that the Coast Guard and CAF examine where common training or exercising can enhance response in areas such as shoreline searches and communications or in a broader community emergency response.

Arctic Maritime Rescue Sub-Centre (MRSC)

In just a few years, there could be over 45 auxiliary units in the Arctic. Based on workload, language and culture, it is recommended that an evaluation be undertaken to determine if an MRSC could be established in the Arctic. This sub-centre could potentially be based at the Marine Communications and Traffic Services (MCTS) Centre in Iqaluit and linked with Emergency Management centres of the regions and territories.

The Arctic RAMSARD study focussed on auxiliary units, not full-time resources. However, collected data and information can be used to support decision-making for the establishment of other assets.

Following the announcement of the IRB-North Station OPP Project in November 2016, data compiled through the RAMSARD study was reviewed to determine the most effective location for establishing the new station.

Challenges and factors inherent to establishing auxiliary units such as finding volunteer responders and a capable vessel became less important as IRB crews are paid and provided with a vessel. However, community support remained an important factor and was considered alongside stability and safety of the communities.

Rankin Inlet ranked high on the factors of social stability and safety of the community while Cape Dorset, another community considered, ranked lower.

Based on a standard assessment that also included typical southern risk-based assessment factors, such as the number of mariners, level of boating activity and existing SAR services, Ranking Inlet (Nunavut) is the recommended location.

Cambridge Bay, Igloolik and Hall Beach also ranked high but already have effective auxiliary units or are expected to have units in 2018. Conversely, Rankin Inlet's auxiliary unit has not been operational for two seasons.

Furthermore, unlike most Arctic communities, Rankin Inlet is in close proximity to 3 other communities. Chesterfield Inlet, Whale Cove and Arviat are all located within 100 nm; mariners from all four communities will be able to benefit from Rankin Inlet IRB Station services.

This location is also highly supported by Government of Nunavut Emergency Management Office.

Table 1 – Arctic Search and Rescue Areas (SRAs)

010	Eastern Arctic (SRR Halifax)
155	Hudson Bay - James Bay
259	All lands and waters of the Northwest Territories
260	All lands and water areas of Nunavut, except the water areas of Hudson and James Bays.

Figure 1 – Map of Arctic Search and Rescue Areas (SRAs)

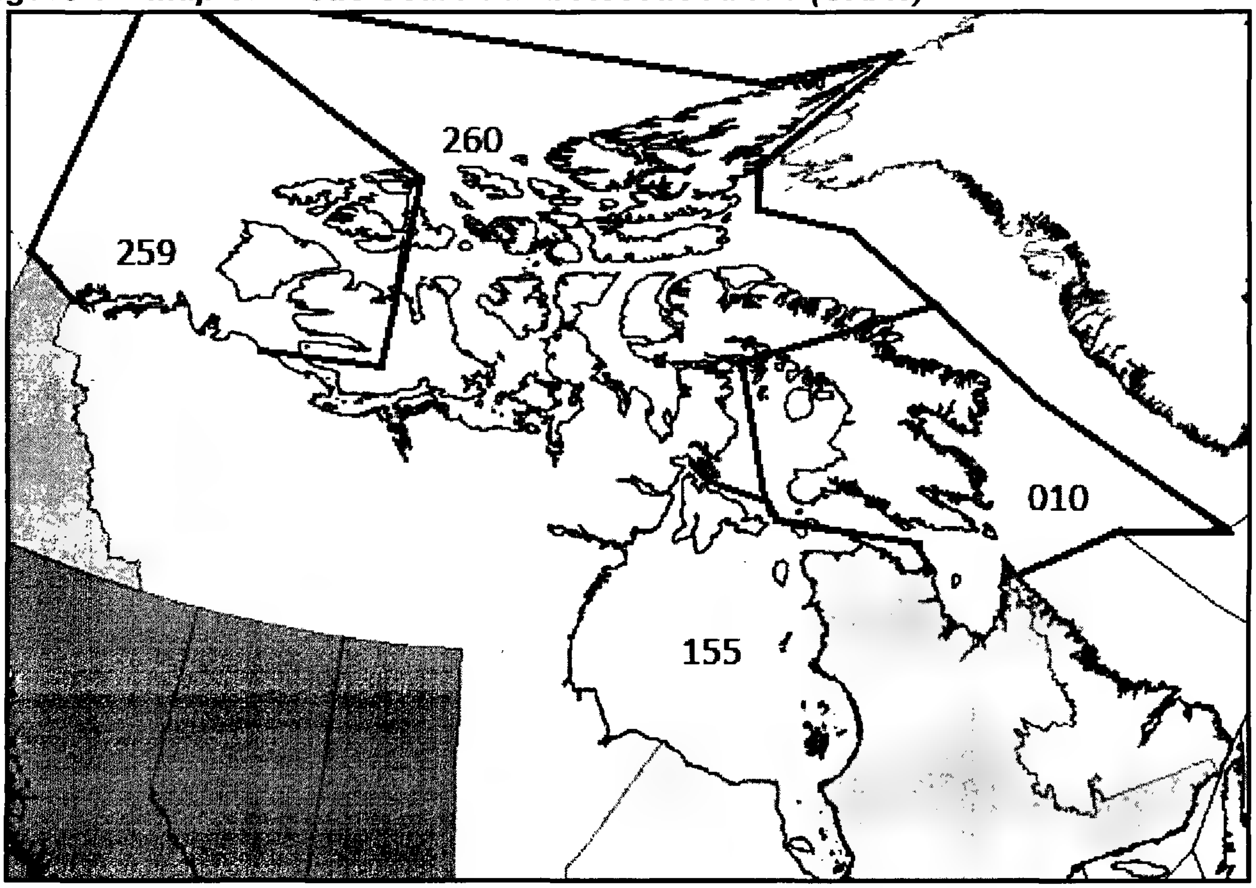


Table 2 – Factors and Descriptions by Category

	Factors and Descriptions – RAMSARD Risk Analysis	
	Factor	Description
Population & Boating Activity	Population	Risk greater with more people
	Number of Boats	Risk greater with more boats in the area
	Size of Boats	Risk if boats are small (less seaworthy)
	Level of Boating Activity	Risk greater with high activity and far distances
	Marine Industry Activity	Risk greater with more marine industry
	Boating Season	Risk greater with longer season
Geo-Enviro	Water	Risk greater if tides, currents and shoals
	Ice During Season	Risk greater if persistent, dynamic ice
	Fog	Risk greater if fog is a prevalent issue
	Unique Winds	Risk greater if extreme local conditions
	Geography	Risk greater if no nearby safe havens
SAR Support	Other SAR Resources	Risk greater if no Coast Guard /RCAF/CASARA
	Local SAR Capacity	Risk greater if no local capacity
	Historic SAR Stats	Risk greater if high numbers
	Communications	Risk greater if no MCTS or Local VHF

	Factors and Descriptions – Community Propensity for Auxiliary Unit*	
	Factor	Description
Social factors & Infrastructure	Support / Enthusiasm	Level of council and community support / enthusiasm
	Safety	Level of safety of employees and assets
	Transportation Access	Availability of good runways for ease of travel
	Infrastructure	Availability of good pier or wharf for vessel(s)
	Services	Availability of medical & mech support
Availability of vessels	Size of Boats	Auxiliary unit requires larger vessel
	Condition of Boats	Auxiliary unit requires a sound vessel
	Number Boats	Number of boats to choose from for auxiliary units
	*Higher rankings in these factors indicate a higher propensity for the community to develop an auxiliary unit.	

Table 3 – Ranking Descriptions (Low, Medium, High) by Factor

	RAMSARD Risk Analysis			
	Factor	Low Ranking (1)	Medium Ranking (2)	High Ranking (3)
Population & Boating Activity	Population	Less than 500	500 to 1500	More than 500
	Number of Boats	Less than 25	25 to 75	More than 75
	Size of Boats	Larger than 26 feet	Medium (18 to 26 feet)	Small (16 to 18 feet)
	Level of Boating Activity	Low-level activity (local)	Some distance to camps	Transient to distant camps
	Marine Industry Activity	Local subsistence only	Local commercial fisheries, tourism	External development - mining
	Length Boating Season	Late July to mid-September	Mid-June to late October	Early June to late October
Geo-Enviro	Water	Minimal tides/currents	Tides 6 - 10 feet	Tides greater than 10 feet
	Ice During Season	Ice clears, no potential for wind jams	Some ice movement / wind jams	Remnant ice and wind jams common
	Fog	Minimal fog issue	Weather dependent	Common foggy conditions
	Unique Winds	Wind associated with low pressures / storms	Seasonal prevailing winds	Predictable strong winds, often
	Geography	Waters are surrounded by inlets, bays, shelter	Nearby islands, inlets, bays	Open water, harsh coastline
SAR Support	Other SAR Resources	Local CASARA, RCAF nearby (shipping corridor)	Close to air resources & shipping corridors	No air resources, not near shipping corridors
	Local SAR Capacity	Has operational CGA unit	Weak CGA or SAR unit	No CGA or local capacity
	Historic SAR Stats	Less than 5 over 5 years	5 over 5 years	More than 5 over 5 years
	Communications	Has MCTS and Local VHF	Has Local or MCTS	No MCTS or Local VHF

	Community Propensity for Auxiliary Unit*			
	Factor	Low Ranking (1)	Medium Ranking (2)	High Ranking (3)
Social factors & Infrastructure	Support. / Enthusiasm	No interest as CGA members or council support	Somewhat supportive	Council and public enthusiastically supportive
	Safety**	High crime / low safety	Medium crime / safety	Low crime / high safety
	Transportation Access	Short, gravel	Long gravel	Long paved
	Marine Infrastructure	Beach only	Ramp or floating wharf	Sea wall, small pier
	Services	Nurses station only	Medical centre (garage)	Hospital, heavy industry
Availability of vessels	Size of Boats	Small (16 to 18 feet)	Medium (18 to 26 feet)	Larger than 26 feet
	Condition of Boats	Damaged hull, jury rigging, no safety gear	Sound hull, functional systems, some gear	Sound hull & systems, all safety gear, radio
	Number Boats	Less than 25	25 to 75	More than 75

*Higher rankings in these factors indicate a higher propensity for the community to receive an auxiliary unit.
**This factor was heavily considered in recommending the location of the IRB station.

Table 4 – Inuvialuit Region (Northwest Territories)

	RAMSARD Risk Factor Rankings						
	Factor	**Inuvik**	**Aklavik**	**Tuktoyaktuk**	**Sachs Harbour**	**Ulukhaktok**	**Paulatuk**
Population & Boating Activity	Population	3	2	2	1	1	1
	Number of Boats	3	2	2	1	2	2
	Size of Boats	2	3	2	3	3	3
	Level of Boating Activity	1	1	2	1	2	2
	Marine Industry Activity	3	1	2	1	1	1
	Length Boating Season	2	1	2	2	2	2
Geo-Enviro	Water	1	1	1	1	1	1
	Ice During Season	1	1	1	1	1	1
	Fog	1	1	2	1	1	1
	Unique Winds	1	1	2	2	2	2
	Geography	1	1	3	3	2	2
SAR Support	Other SAR Resources	1	2	2	3	3	3
	Local SAR Capacity	1	2	1	3	3	3
	Historic SAR Stats	2	2	2	1	1	1
	Communications	2	1	1	3	3	3
	Totals	**25**	**22**	**27**	**27**	**28**	**28**

	Community Propensity for Auxiliary Unit Factor Rankings						
	Factor	**Inuvik**	**Aklavik**	**Tuktoyaktuk**	**Sachs Harbour**	**Ulukhaktok**	**Paulatuk**
Social factors & Infrastructure	Support / Enthusiasm	3	1	3	1	3	2
	Safety	2	3	3	3	3	3
	Transportation Access	3	1	2	1	1	1
	Marine Infrastructure	3	1	2	1	1	1
	Services	3	1	2	1	1	1
Availability of vessels	Size of Boats	2	3	2	3	3	3
	Condition of Boats	1	1	1	1	1	1
	Number Boats	3	1	1	1	1	1
	Totals	**20**	**12**	**16**	**12**	**14**	**13**

Table 5 – Kitikmeot Region (Nunavut)

RAMSARD Risk Factor Rankings

	Factor	Kuugaruk	Taloyoak	Gjoa Haven	Cambridge Bay	Kugluktuk
Population & Boating Activity	Population	2	2	3	3	3
	Number of Boats	1	1	1	2	2
	Size of Boats	3	3	3	2	2
	Level of Boating Activity	1	2	2	2	2
	Marine Industry Activity	1	1	3	3	2
	Length Boating Season	2	2	2	2	2
Geo-Enviro	Water	2	2	1	1	1
	Ice During Season	2	2	2	2	1
	Fog	2	2	2	2	2
	Unique Winds	2	1	1	1	1
	Geography	1	1	1	1	1
SAR Support	Other SAR Resources	3	3	3	3	3
	Local SAR Capacity	3	3	3	1	1
	Historic SAR Stats	1	1	1	1	1
	Communications	3	3	3	2	3
	Totals	**29**	**29**	**31**	**28**	**27**

Community Propensity for Auxiliary Unit Factor Rankings

	Factor	Kuugaruk	Taloyoak	Gjoa Haven	Cambridge Bay	Kugluktuk
Social factors & Infrastructure	Support / Enthusiasm	2	2	3	3	3
	Safety	2	3	2	3	3
	Transportation Access	2	2	2	1	2
	Infrastructure	1	1	2	3	2
	Services	2	2	2	3	2
Availability of vessels	Size of Boats	1	1	1	2	2
	Condition of Boats	1	1	1	2	2
	Number Boats	1	1	1	2	2
	Totals	**12**	**13**	**14**	**19**	**18**

Appendix B

Table 6 – Kivalliq Region (Nunavut)

RAMSARD Risk Factor Rankings

	Factor	Arviat	Whale Cove	Rankin Inlet	Chesterfield Inlet	Naujaat	Coral Harbour	Baker Lake*
Population & Boating Activity	Population	2	2	3	3	3	3	3
	Number of Boats	2	2	3	2	2	2	Unknown
	Size of Boats	3	3	2	3	2	3	Unknown
	Level of Boating Activity	3	3	3	3	2	2	Unknown
	Marine Industry Activity	1	1	3	3	2	3	2
	Length Boating Season	2	2	2	2	2	2	2
Geo-Enviro	Water	2	2	2	2	2	2	2
	Ice During Season	2	2	2	2	2	2	2
	Fog	2	2	2	2	2	2	Unknown
	Unique Winds	2	2	2	2	2	2	Unknown
	Geography	1	1	2	2	1	2	1
SAR Support	Other SAR Resources	2	2	2	2	2	2	2
	Local SAR Capacity	3	3	3	3	2	3	Unknown
	Historic SAR Stats	2	2	2	2	2	2	Unknown
	Communications	3	3	3	3	3	3	3
	Totals	**32**	**32**	**36**	**36**	**31**	**35**	**17**

Community Propensity for Auxiliary Unit Factor Rankings

	Factor	Arviat	Whale Cove	Rankin Inlet	Chesterfield Inlet	Naujaat	Coral Harbour	Baker Lake*
Social factors & Infrastructure	Support / Enthusiasm	2	1	2	2	2	2	Unknown
	Safety	3	3	2	3	3	3	1
	Transportation Access	2	1	3	1	1	1	1
	Marine Infrastructure	2	1	3	1	2		2
	Services	2	1	3	1	2	2	2
Availability of vessels	Size of Boats	1	1	2	1	1	1	Unknown
	Condition of Boats	1	1	1	1	1	1	2
	Number Boats	1	1	3	1	1	1	Unknown
	Totals	**14**	**10**	**19**	**11**	**13**	**11**	**8**

* Baker Lake is not located in Coast Guard SAR mandated waters and is therefore not eligible for a unit.

Table 7 – Qikiqtaaluk Region (Nunavut)

RAMSARD Risk Factor Rankings

	Factor	Iqaluit	Pangnirtung	Qikitarjjuaq	Clyde River	Pond Inlet	Arctic Bay	Cape Dorset	Kimmirut	Sanikiluaq	Igloolik	Hall Beach	Grise Fjord	Resolute
Population & Boating	Population	3	2	2	2	2	1	2	1	3	2	2	3	3
	Number of Boats	3	2	2	2	2	3	2	2	2	2	2	1	2
	Size of Boats	2	2	2	2	2	2	3	3	3	2	2	3	3
	Level of Boating Activity	3	2	2	2	3	3	3	2	2	3	3	1	1
	Marine Industry Activity	3	3	1	1	2	1	1	1	1	1	1	1	2
	Length Boating Season	2	2	2	2	2	2	3	2	2	2	2	1	1
Geo-Enviro	Water	3	3	2	2	2	1	2	2	1	2	2	3	3
	Ice During Season	2	2	1	1	2	2	1	1	1	2	2	3	3
	Fog	2	2	1	1	2	2	1	1	2	2	2	2	2
	Unique Winds	2	3	2	2	2	2	2	2	2	2	2	3	3
	Geography	2	3	2	2	2	2	3	2	2	2	2	2	2
SAR Support	Other SAR Resources	2	3	3	3	3	3	3	3	3	3	3	3	1
	Local SAR Capacity	2	1	3	3	3	3	3	3	3	3	3	3	3
	Historic SAR Stats	2	2	2	2	3	3	2	2	2	2	2	2	2
	Communications	1	2	3	2	3	3	3	3	3	3	3	2	2
	Totals	**34**	**34**	**30**	**29**	**35**	**33**	**34**	**30**	**32**	**33**	**33**	**33**	**33**

Community Propensity for Auxiliary Unit Factor Rankings

	Factor	Iqaluit	Pangnirtung	Qikitarjjuaq	Clyde River	Pond Inlet	Arctic Bay	Cape Dorset	Kimmirut	Sanikiluaq	Igloolik	Hall Beach	Grise Fjord	Resolute
Social factors & Infrastructure	Support / Enthusiasm	2	3	3	3	3	3	2	3	2	3	3	2	2
	Safety	2	3	3	3	3	3	1	3	3	3	3	3	3
	Transportation Access	3	2	2	2	2	2	2	1	1	2	2	1	3
	Marine Infrastructure	3	3	2	1	1	1	1	1	1	1	1	1	1
	Services	3	2	2	2	2	1	2	1	1	2	2	1	1
Vessels	Size of Boats	2	2	1	1	2	1	2	1	1	2	2	1	1
	Condition of Boats	2	2	1	1	2	1	1	1	1	1	1	1	1
	Number Boats	3	2	1	1	2	1	2	1	1	2	2	1	1
	Totals	**20**	**19**	**15**	**14**	**17**	**13**	**13**	**12**	**11**	**16**	**16**	**11**	**13**

Table 8 – Hudson Bay Region (Nunavik)

	RAMSARD Risk Factor Rankings						
	Factor	**Ivujivik**	**Akulivik**	**Puvirnituq**	**Inukjuak**	**Umiujaq**	**Kuujuarapik**
Population & Boating Activity	Population	1	2	3	3	1	2
	Number of Boats	2	2	2	2	2	2
	Size of Boats	1	1	1	1	1	1
	Level of Boating Activity	2	2	2	2	2	2
	Marine Industry Activity	1	1	1	1	1	1
	Length Boating Season	2	2	2	2	2	2
Geo-Enviro	Water	2	2	2	2	2	2
	Ice During Season	2	2	2	2	2	2
	Fog	2	2	2	2	2	2
	Unique Winds	2	2	2	2	2	2
	Geography	2	2	2	2	2	2
SAR Support	Other SAR Resources	1	1	1	1	1	1
	Local SAR Capacity	3	3	3	3	3	3
	Historic SAR Stats	1	1	1	1	1	1
	Communications	3	3	3	3	3	3
	Totals	**27**	**28**	**29**	**29**	**27**	**28**

	Community Propensity for Auxiliary Unit Factor Rankings						
	Factor	**Ivujivik**	**Akulivik**	**Puvirnituq**	**Inukjuak**	**Umiujaq**	**Kuujuarapik**
Social factors & Infrastructure	Support / Enthusiasm	2	2	2	2	2	2
	Safety	2	2	2	2	2	2
	Transportation Access	2	2	1	2	2	2
	Marine Infrastructure	2	2	2	2	2	2
	Services	1	2	3	3	1	2
Availability of vessels	Size of Boats	1	1	1	1	1	1
	Condition of Boats	1	1	1	1	1	1
	Number Boats	2	2	2	2	2	2
	Totals	**13**	**14**	**14**	**15**	**13**	**14**

Table 9 – Hudson Strait & Ungava Bay Region (Nunavik)

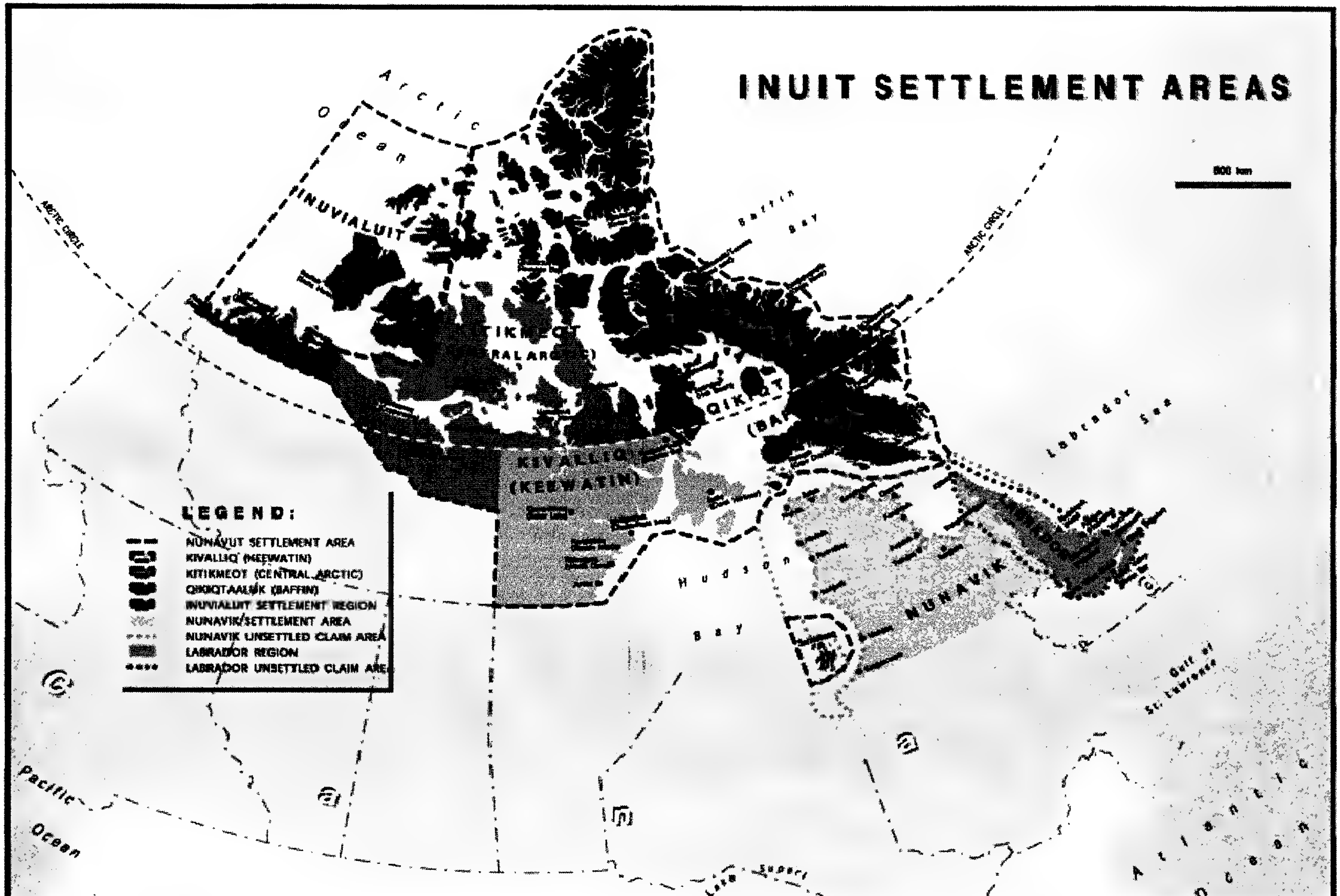
RAMSARD Risk Factor Rankings

	Factor	Kuujjuaq	Kangirsualujjuaq	Tasiujuaq	Aupuluk	Kangirsuk	Quaqtaq	Kangisujuaq	Salliut
Population & Boating	Population	3	1	1	1	2	1	2	3
	Number of Boats	2	1	1	1	2	1	2	2
	Size of Boats	1	1	1	1	1	1	1	1
	Level of Boating Activity	2	2	2	2	2	2	2	2
	Marine Industry Activity	2	1	1	1	1	1	1	2
	Length Boating Season	2	2	2	2	2	2	2	2
Geo-Enviro	Water	3	3	2	2	3	2	3	3
	Ice During Season	3	3	3	3	3	3	3	3
	Fog	2	2	2	2	2	2	2	2
	Unique Winds	2	2	2	2	2	2	2	2
	Geography	2	2	2	2	2	2	2	2
SAR Support	Other SAR Resources	3	3	3	3	3	3	3	3
	Local SAR Capacity	2	2	2	2	2	2	2	2
	Historic SAR Stats	1	1	1	1	1	1	1	1
	Communications	3	3	3	3	3	3	3	3
	Totals	**33**	**29**	**28**	**28**	**31**	**28**	**31**	**33**

Community Propensity for Auxiliary Unit Factor Rankings

	Factor	Kuujjuaq	Kangirsualujjuaq	Tasiujuaq	Aupuluk	Kangirsuk	Quaqtaq	Kangisujuaq	Salliut
Social factors & Infrastructure	Support / Enthusiasm	3	3	3	3	3	3	3	3
	Safety	2	2	2	2	2	2	2	2
	Transportation Access	3	2	2	2	2	2	2	2
	Marine Infrastructure	3	3	3	3	3	3	3	3
	Services	3	2	2	2	2	2	2	3
Vessels	Size of Boats	1	1	1	1	1	1	1	1
	Condition of Boats	1	1	1	1	1	1	1	1
	Number Boats	2	1	1	1	2	1	2	2
	Totals	**18**	**15**	**15**	**15**	**16**	**15**	**16**	**17**

Figure 2 – Map of Inuit Settlement Areas



Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Sécurité d'abord, Service constant

Mises à jour de l'étude RAMSARD dans l'Arctique

Garde côtière canadienne

Région du Centre et de l'Arctique

Le 19 janvier 2018

Auteur :

Peter Garapick, surintendant, Recherche et sauvetage dans l'Arctique, Région du Centre et de l'Arctique

Canada

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Sommaire

La Garde côtière auxiliaire canadienne est le principal organisme bénévole de recherche et de sauvetage (SAR). Grâce à elle, les collectivités de l'Arctique peuvent développer leur capacité à répondre efficacement aux urgences maritimes pour sauver la vie de leurs proches ou de leurs concitoyens partis chasser ou pêcher sur les eaux.

Pour appuyer la création de ces unités auxiliaires dans l'Arctique, la Région du Centre et de l'Arctique de la Garde côtière a lancé en 2015 une Analyse axée sur les risques de la prestation des services de recherche et de sauvetage maritimes (RAMSARD). Cette étude a pour but d'évaluer systématiquement les risques pour les navigateurs dans les zones de recherche et de sauvetage, et de déterminer où il serait possible d'ajouter, de renforcer ou de retirer certains atouts. Depuis le lancement du projet en automne 2015, l'équipe du RAMSARD a constaté plusieurs avancées importantes dans l'Arctique qui ne se traduisent pas uniquement dans le nombre de nouvelles unités auxiliaires, mais aussi à travers les nouvelles relations positives établies entre la Garde côtière et plusieurs intervenants de l'Arctique.

La méthodologie de l'analyse RAMSARD, en partie décrite aux présentes, s'appuie solidement sur les lignes directrices de l'Association canadienne de normalisation (CSA), notamment les lignes directrices CAN/CSA-Q850-97, qui décrivent un processus pour recueillir, analyser, évaluer et communiquer l'information nécessaire à la prise de décisions. Toutefois, comme l'ont souligné les concepteurs de la méthodologie, le système maritime et aéronautique de recherche et sauvetage (R et S) diffère à plusieurs égards des situations prévues par les lignes directrices CSA-Q850 quant à l'analyse des risques et la prise de décisions. Cette divergence, combiné avec le besoin d'une méthodologie normalisée à travers l'organisation, posent des défis quant à l'élaboration d'un modèle de production de rapports qui serviront à documenter et à communiquer les mises à jour liées à une analyse RAMSARD.

Sommaire

En l'absence d'un modèle officiel de production de rapports, le présent document décrit : les principales considérations touchant l'application de la méthodologie dans l'Arctique, les résultats initiaux ainsi que les résultats actuels issus des consultations et de la collecte de données, les leçons apprises et les pratiques exemplaires déterminées, les prochaines étapes et enfin, les nouveaux enjeux connexes ainsi que les recommandations pour aller de l'avant. L'**annexe B** présente une analyse détaillée pour chaque collectivité, y compris le classement des différentes collectivités pour chacun des facteurs abordés dans cette étude.

Contexte

La méthodologie de l'analyse RAMSARD de la Garde côtière a été conçue pour évaluer les risques pour les navigateurs dans les zones de recherche et de sauvetage dans les eaux relevant de la compétence de la Garde côtière, afin de déterminer où il serait possible d'ajouter, de renforcer ou de retirer certains actifs. Initialement, ce processus visait : «les eaux du Pacifique, des Grands Lacs, du fleuve Saint-Laurent et du golfe du Saint-Laurent, ainsi que des régions de l'Atlantique», où les actifs sont situés et/ou, où les clients traditionnels de la Garde côtière opèrent.

L'étude de l'analyse RAMSARD dans l'Arctique vise quant à elle les eaux de l'océan Arctique, allant de la mer de Beaufort (à l'est) au détroit d'Hudson (à l'ouest), et les eaux du delta du Mackenzie et de la baie d'Hudson. Cette géographie se subdivise en 4 zones de recherche et de sauvetage (010, 155, 259 et 260) couvrant une superficie totale de 2 200 100 NM^2, ce qui équivaut à une moyenne de 500 025 NM^2 par zone; la plus grande mesurant 996 600 NM^2 et la plus petite mesurant 139 700 NM^2. **L'annexe A** présente une liste et une carte de ces zones.

L'étude s'est concentrée sur 45 collectivités inuites vivant dans ces régions. Cependant, il est à noter que la collectivité de Baker Lake au Nunavut n'est pas située dans les eaux relevant de la compétence de la Garde côtière. Ainsi, cela réduit les collectivités admissibles à une unité auxiliaire au nombre de 44. Sont également exclues les 10 collectivités cries de la baie James sur les rives de l'Ontario et du Québec, ainsi que les 6 collectivités Inuites de Nunatsiavut (Labrador). L'**annexe B** présente une carte des collectivités par région du règlement des Inuit. Par ailleurs, l'étude s'est uniquement penchée sur les possibilités d'établissement d'unités auxiliaire, et non sur l'établissement de poste de bateaux de sauvetage ou d'embarcation de sauvetage côtier de la Garde côtière.

Contexte

Les collectivités de l'Arctique sont isolées, des centaines de kilomètres les séparant les unes des autres, et s'étendent sur un vaste territoire où les conditions maritimes sont difficiles. La présence locale d'unités auxiliaires compétentes permettrait de répondre efficacement et en temps opportun à la majorité des urgences maritimes dans la région, qui impliquent généralement les petites embarcations des collectivités. Cela réduirait la dépendance à d'autres actifs comme les brise-glaces ou les aéronefs de l'Aviation royale canadienne (ARC), qui sont souvent situés à des heures, voire à des journées du lieu d'un incident, permettant aussi à ces actifs de demeurer disponibles pour des opérations où ils pourraient s'avérer plus efficaces.

Application de la méthodologie de l'analyse RAMSARD dans le Nord

La méthodologie utilisée pour recueillir les données et acquérir des connaissances sur les eaux et sur les collectivités de l'Arctique a nécessité de nombreux déplacements dans les régions afin de rassembler un éventail de renseignements qualitatifs (lors de rencontres avec les populations nordiques) et quantitatifs (des statistiques principalement fournies par les organismes de R et S et des organismes environnementaux du Sud.

L'équipe de l'analyse RAMSARD était composé des membres de la Région du Centre et de l'Arctique et des Stratégies nationales de la Garde côtière, des membres de la Garde côtière auxiliaire (Centre et Arctique inc. et Québec inc.), ainsi que des partenaires des gouvernements du Nunavut et du Nunavik. Depuis le commencement en décembre 2015, l'équipe a effectué 14 voyages en Arctique à bord d'un avion nolisé, visitant parfois jusqu'à deux ou trois collectivités de l'Arctique en une journée. Ces visites ont permis à l'équipe de s'entretenir et de tisser des liens avec les représentants élus, des employés issus des collectivités, des chasseurs et des trappeurs, des intervenants de première ligne et des citoyens. La Garde côtière auxiliaire Centre et Arctique inc. s'est avérée une source d'information particulièrement utile, cet organisme comptant 9 unités dans l'Arctique depuis presque 15 ans.

Lorsqu'une analyse RAMSARD est effectuée dans le Sud, la méthodologie appliquée se concentre habituellement sur l'évaluation des niveaux de risque d'un certain nombre de facteurs pour en arriver à déterminer l'emplacement où il serait le plus stratégique de positionner un atout de R et S ou d'accorder la priorité à l'établissement d'une unité auxiliaire. Les facteurs étudiés dans une analyse RAMSARD se rapportent généralement au type et au niveau des activités maritimes; aux conditions météorologiques et géographiques dominantes; et aux services de R et S qui existent dans la région.

Dans le Nord, par contre, plusieurs facteurs types d'une analyse RAMSARD ont mené à des constatations semblables d'une collectivité à l'autre, ne permettant pas à la Garde côtière d'établir un ordre des priorités pour l'établissement d'unités. Comparativement

au Sud, les collectivités nordiques pratiquent peu la navigation de plaisance et posent des risques élevés en termes de conditions météorologiques et géographiques. La plupart des collectivités sont isolées et sont dépourvues d'un service de R et S dans leur région. L'objectif étant l'établissement d'unités bénévoles de R et S – et non de ressources de la Garde côtière à plein temps – il était impératif de trouver des volontaires et d'obtenir l'appui général des collectivités. Par conséquent, cette étude s'est aussi penchée sur des facteurs sociaux comme l'enthousiasme, la disponibilité de l'infrastructure et des services, ainsi que la disponibilité de navires aptes à effectuer des opérations de R et S.

Aux fins de l'analyse RAMSARD dans le Nord, les facteurs sociaux, l'infrastructure et la disponibilité des services et des navires adéquats jouent bien souvent un rôle plus important que les facteurs habituels d'une telle analyse. Ils servent effectivement à déduire la propension d'une collectivité à mettre sur pied une unité auxiliaire, aidant la Garde côtière à établir un ordre des priorités pour l'établissement d'unités auxiliaires. Ces facteurs sont décrits plus en détail ci-dessous.

Appui et enthousiasme de la collectivité

Il est beaucoup plus difficile de trouver entre 15 et 20 répondants enthousiastes dans de petites collectivités isolées que dans les régions du Sud. Les groupes, les activités et les événements d'une collectivité doivent aussi obtenir l'appui du Conseil communautaire. Le Conseil peut donner son appui en fournissant à l'unité auxiliaire un bureau et une salle des opérations, des zones d'entreposage pour l'équipement ou les bateaux, et un financement pour les frais non couverts par les accords de contribution de la GCAC.

Les collectivités parvenant à former un groupe de répondants intéressés et dont le Conseil soutenait l'initiative étaient mieux classées quant à leur propension à établir une unité.

Infrastructure et disponibilité des services

Il est essentiel de pouvoir disposer de pistes ou de surfaces d'atterrissage, de jetées ou de quais, et d'un soutien médical et de services de mécanique pour appuyer les opérations de R et S, qu'il s'agisse de ravitailler une unité auxiliaire, de réparer les bateaux endommagés ou de soigner ou évacuer les survivants. Les collectivités dont le niveau d'infrastructure et de services était jugé suffisant pour appuyer les opérations d'une unité auxiliaire étaient mieux classées quant à la propension à établir une unité.

Disponibilité de navires adéquats

Même si le niveau d'appui communautaire et la disponibilité de l'infrastructure et des services sont suffisants, la Garde côtière ne pourrait certifier une embarcation non sécuritaire, et le Centre de coordination des opérations de sauvetage (CCOS) ne pourrait confier une mission à une telle embarcation.

Les collectivités ayant pu identifier un ou plusieurs navires jugés adéquats, de la bonne taille et en bon état, étaient mieux classées quant à leur propension à établir une unité.

Premiers résultats (été 2016)

Au terme de la première série de visites de 2015, chaque collectivité a été classée selon les données recueillies pour chaque facteur évalué par l'étude. L'**annexe B** en présente une analyse détaillée de chaque collectivité, y compris le classement de chacune par rapport aux facteurs de risques habituels d'une analyse RAMSARD, et par rapport aux facteurs liés à leur propension à établir une unité auxiliaire.

Dans l'ensemble, on a jugé que les conditions météorologiques et maritimes (état des glaces, état de la mer) étaient les mêmes pour toutes collectivités, cela n'étant donc pas un facteur déterminant. Les saisons intermédiaires (déglacement au printemps; englacement en automne) posent de plus hauts risques pour les navigateurs, peu importe l'emplacement et la durée de la saison.

Toutefois, il a été déterminé que la durée de la saison des eaux libres était de plus grande importance que l'activité des bateaux. Une courte saison de navigation s'accompagne d'une plus faible intensité d'activité, et comporte moins de risques qu'une plus longue saison des eaux libres. Comme prévu, les facteurs les plus influents étaient le niveau d'enthousiasme et de soutien communautaire, le niveau d'infrastructure, et la disponibilité des services et de navires aptes à effectuer des opérations de R et S.

Collectivités les **mieux classées** quant à leur propension à établir une unité :

- Igloolik
- Hall Beach
- Iqaluit
- Clyde River
- Qikiqtarjuaq
- Cape Dorset
- Kimmirut
- Paulatuk
- Toutes les collectivités du Nunavik (14 ont une embarcation et un équipage de R et S non auxiliaires)

Collectivités les **moins bien classées** quant à leur propension à établir une unité :

- Sachs Harbour
- Fjord Grise
- Resolute
- Whale Cove
- Ulukhaktok
- Gjoa Haven

Résultats actuels (été 2017)

L'été 2017 a donné l'occasion de réexaminer et de valider les classements initiaux, et de compléter une évaluation exhaustive de chaque collectivité. L'**annexe B** présente les résultats de la plus récente analyse effectuée auprès de chaque collectivité, y compris leur classement pour chaque facteur.

L'été 2017 a aussi donné lieu à des résultats intéressants concernant les unités auxiliaires devenues opérationnelles.

Les collectivités suivantes, initialement mieux classées quant à leur propension à établir une unité auxiliaire, ne sont pas parvenues à en établir une :

- Igloolik
- Hall Beach
- Clyde River

À l'opposé, de plus petites collectivités, initialement moins bien classées quant à leur propension à établir une unité auxiliaire, sont parvenues à rassembler 20 répondants prêts à s'engager au sein d'une unité auxiliaire, ainsi qu'un navire adéquat, en plus d'obtenir tout l'appui du Conseil communautaire. Les collectivités suivantes ont montré d'excellents résultats et possèdent aujourd'hui une unité auxiliaire entièrement opérationnelle :

- Ulukhaktok
- Gjoa Haven

Dans l'ensemble des collectivités du Nunavik, la disponibilité de navires et d'équipages de R et S n'appartenant pas à la Garde côtière auxiliaire canadienne (GCAC) présentait initialement une excellente occasion d'y établir 14 nouvelles unités en 2017. Toutefois, en raison d'enjeux imprévus touchant la définition des rôles et la communication entre l'Administration régionale Kativik (ARK) et la GCAC Québec inc., des unités auxiliaires ont seulement pu être créées dans les collectivités suivantes :

- Kuujjuaq
- Salluit

Leçons apprises et pratiques exemplaires déterminées

Approche avec les collectivités

Depuis le lancement du projet, les de l'équipe du RAMSARD dans l'Arctique a constaté plusieurs avancées importantes qui ne se mesurent pas uniquement dans le nombre de nouvelles unités, mais aussi à travers les nouvelles relations positives établies entre la Garde côtière et les administrations territoriales et régionales, les organismes de l'Arctique, les représentants communautaires et les populations inuites de l'Arctique.

L'approche de l'équipe est grandement axée sur la sensibilisation culturelle, le respect et la transparence à tous les niveaux, envers les individus comme envers les collectivités et les administrations ou organismes régionaux ou territoriaux. Une fois le soutien des plus hauts paliers du gouvernement confirmé, l'équipe mise sur une approche au niveau local et communautaire; cette stratégie se voulant la plus efficace pour l'établissement réussi de nouvelles unités.

Pour connaître d'aussi bons résultats, l'équipe de l'analyse RAMSARD a profité de la bonne réputation de la Garde côtière, un organisme fédéral respecté des collectivités de l'Arctique. Le modèle adopté pour l'établissement d'unités auxiliaires prend la forme d'un programme bénévole, et l'équipe de l'analyse RAMSARD a très bien réussi à le présenter comme la voie à suivre pour mettre sur pied un service de R et S communautaire efficace dans l'Arctique.

Les régions auxiliaires du Québec, et du Centre et de l'Arctique ont aussi prêté main-forte, accordant tout leur appui aux nouveaux membres inuits, avec souplesse, enthousiasme et patience, tout en faisant preuve d'une grande sensibilité culturelle. Ainsi, elles ont assuré la traduction de documents et commencé à apporter les changements nécessaires à leur programme en fonction des besoins de l'Arctique.

Le transport par avion nolisé s'avère le meilleur moyen de voyager d'une collectivité de l'Arctique à l'autre. Lors de chaque visite, le fait que les membres désignés de l'équipe puissent travailler étroitement avec les collectivités s'est avéré un important facteur de réussite. Aussi, en raison des enjeux liés au climat, il était crucial de pouvoir profiter d'une certaine souplesse touchant les horaires de voyage.

Leçons apprises et pratiques exemplaires déterminées

Leadership inuit

Le réseau actuel de la Garde côtière auxiliaire dans les régions du Sud est le résultat de 40 années d'efforts et de leadership au sein de la communauté auxiliaire. Pour assurer le maintien des efforts dans l'Arctique, il est impératif d'établir des postes occupé par des Inuits dans les régions nordiques. Des rôles de leadership sont en cours d'élaboration ou ont déjà été offerts à de nouveaux membres inuits afin de garantir que les programmes du Nord soient gérés par des gens du Nord.

L'établissement et le maintien des unités doivent aussi pouvoir s'appuyer sur un service administratif leur étant consacré. Suivant l'exemple de la GCAC Centre et Arctique inc., la GCAC Québec inc. a embauché un administrateur uniquement pour les unités de la Garde côtière auxiliaire dans l'Arctique. Dans chacune des deux régions, ce rôle fournit un appui administratif à l'ensemble des unités de R et S de la GCAC, actuelles ou potentielles, au sein des collectivités. Les conseils d'administration de la GCAC Centre et Arctique Inc. et de la GCAC Québec Inc. ont créé de nouveaux postes bénévoles dédiés à la formation et aux opérations dans l'Arctique.

Formation

On a observé que la formation pour les unités auxiliaires du Québec et de celles du Centre et de l'Arctique nécessitait de composer avec d'importantes contraintes. La distance, le temps de déplacement, la disponibilité des instructeurs et les coûts connexes se sont avérés être des obstacles à l'établissement de nouvelles unités opérationnelles. Bien que la GCAC Québec inc. ait réussi à certifié 4 instructeurs Inuits, le nombre fut limité à cause des enjeux susmentionnés.

L'ACN ayant été informée de cette situation, des discussions avec les Stratégies nationales ont permis de débloquer des fonds pour les activités de formation de chacune des deux régions auxiliaires dans l'Arctique en hiver 2018. Les deux régions auxiliaires coordonnent également leurs efforts dans le cadre d'un « blitz » de formation, partageant les ressources et les instructeurs, et uniformisant les cours pour les nouveaux membres auxiliaires à l'échelle de l'Arctique.

Prochaines étapes en 2018

Les plans pour 2018 s'appuient sur les résultats actuels de l'analyse RAMSARD et les leçons apprises.

Les différends en matière de gouvernance et de communication entre l'Administration régionale Kativik et la GCAC Québec inc. ayant été résolus, il sera possible d'adopter une approche plus souple et dynamique pour élargir le nombre de membres et établir des unités dans les 12 collectivités restantes du Nunavik.

L'équipe de R et S dans l'Arctique de la région Centre et Arctique compte envoyer des responsables de la formation pour visiter chaque unité et s'assurer qu'elles demeurent actives, opérationnelles et prêtes à intervenir de façon sécuritaire et efficace en cas d'urgence. On continuera à tirer parti de l'expertise et du leadership des unités existantes dans la région du nord du Québec et de la région du Centre et de l'Arctique.

L'équipe de l'analyse RAMSARD en Arctique collaborera avec le groupe de travail du projet d'embarcations communautaires – une initiative complémentaire du Plan de protection des océans (PPO) visant à renforcer l'engagement envers des services de R et S efficaces et durables dans l'Arctique – et visitera à nouveau les collectivités pour aider à établir des unités et accroître la sensibilisation touchant le processus de demande relatif aux bateaux communautaires.

Dans le cadre de ces initiatives, les équipes dans l'Arctique continueront à tirer parti des relations établies avec les administrations et les organismes régionaux ou territoriaux, les conseils communautaires et les individus pour veiller à l'efficacité du système national de R et S d'un océan à l'autre.

Les travaux effectués dans le cadre des initiatives susmentionnées devraient se traduire par une augmentation du nombre d'unités auxiliaires dans l'Arctique. En s'appuyant sur les éléments probants de la présente étude pour établir les priorités de mise en œuvre, plusieurs nouvelles collectivités Inuits et Inuvialuits devraient avoir une unité auxiliaire d'ici le printemps 2020.

Prochaines étapes en 2018

Enfin, quant à la mise en œuvre d'une méthodologie uniformisée d'analyse RAMSARD au sein de la Garde côtière, les ressources supplémentaires de l'ACN ainsi que la formation officielle fournie en 2018 à l'ensemble des surintendants de R et S devraient produire des résultats positifs. Cette formation et ces ressources permettront de peaufiner les processus et, idéalement, d'établir les modèles officiels de production de rapports qui serviront à documenter et à communiquer les mises à jour liées à une analyse RAMSARD.

Chapitre de la Garde côtière auxiliaire dans l'Arctique

Les défis à relever dans l'Arctique seront toujours différents des autres. L'Arctique canadien ne pourrait être gouverné comme on gouverne le Sud du pays. Les besoins en formation dans le Nord sont également uniques. Il sera toutefois important d'uniformiser la formation fournie dans l'Arctique, peu importe les frontières régionales de la Garde côtière et des unités auxiliaires. La voie à suivre devra reposer sur une solution « conçue dans le Nord pour les gens du Nord » de façon à assurer le maintien et l'efficacité du service de R et S. À long terme, on verra l'établissement d'un véritable Chapitre de Garde côtière auxiliaire dans l'Arctique. Il pourrait également devenir nécessaire d'envisager l'achat de navires de R et S pour les collectivités ne disposant pas de ressources locales. Il serait alors recommandé d'acheter des navires de la même catégorie afin d'en faciliter la réparation et le transfert. Ces navires pourraient éventuellement être confiés au chapitre de l'Arctique et ajoutés à leurs actifs.

Rangers canadiens et Garde côtière auxiliaire canadienne

Avant de commencer la présente étude, une évaluation avait été réalisée pour déterminer si les Rangers canadiens pouvaient jouer un rôle officiel dans l'établissement d'unités auxiliaires dans l'Arctique. En raison de certaines différences entre les organismes, il a été déterminé que la Garde côtière devrait se concentrer sur un modèle auxiliaire. En fin de compte, les inquiétudes voulant que le modèle de GCAC bénévole ne puisse attirer de membres comparativement au modèle rémunéré des Rangers canadiens se sont avérées non fondées. En fait, chaque unité auxiliaire compte au moins un membre faisant aussi partie des Rangers.

À l'avenir, il est recommandé que la Garde côtière et les Forces armées canadiennes se penchent sur des formations et des exercices communs pouvant améliorer le service d'intervention dans des domaines comme les recherches et communications côtières, ou la capacité d'intervention générale des collectivités en cas d'urgence.

Centre secondaire de sauvetage maritime (CSSM) de l'Arctique

Dans seulement quelques années, il pourrait y avoir plus de 45 unités auxiliaires dans l'Arctique. Il est recommandé de procéder à une évaluation qui tienne compte de la charge de travail, du langage et de la culture permettant de déterminer s'il serait possible d'établir un CSSM dans l'Arctique. Ce centre secondaire pourrait éventuellement s'établir dans les bureaux du Centre des Services de communication et de trafic maritimes (SCTM) d'Iqaluit, en lien avec les centres de gestion des urgences des régions ou des territoires.

Addenda (Station d'ESC du Nord – emplacement recommandé)

L'analyse RAMSARD dans l'Arctique s'est concentrée sur les unités auxiliaires, et non sur les ressources à plein temps. Cependant, les données et renseignements recueillis pourront appuyer la prise de décisions relatives à l'établissement d'autres actifs.

Depuis l'annonce, en novembre 2016, du projet de la station d'ESC du Nord dans le cadre du PPO, les données compilées par l'analyse RAMSARD ont fait l'objet d'un examen visant à déterminer le meilleur emplacement où établir la nouvelle station.

Les défis et les facteurs inhérents à l'établissement des unités auxiliaires, comme de trouver des volontaires et un navire de R et S, sont devenus moins importants puisque les équipages d'ESC sont rémunérés et se voient fournir un navire. Cependant, l'appui des collectivités est demeuré un facteur d'importance, au même titre que les questions de stabilité et de sécurité au sein des collectivités.

La collectivité de Rankin Inlet a obtenu un classement élevé par rapport aux facteurs de stabilité sociale et de sécurité, alors que Cape Dorset obtenait un classement inférieur.

Selon une évaluation standard analysant également les facteurs d'évaluation du risque habituellement utilisés dans les régions du Sud, y compris le nombre de navigateurs, l'intensité de l'activité nautique et les services de R et S existants, Rankin Inlet (Nunavut) est l'emplacement recommandé.

Cambridge Bay, Igloolik et Hall Beach ont aussi obtenu un classement élevé, mais possèdent déjà des unités auxiliaires efficaces ou devraient en posséder dès 2018. De son côté, l'unité auxiliaire de Rankin Inlet n'est plus opérationnelle depuis deux saisons de navigation.

En outre, à la différence de la plupart des collectivités de l'Arctique, Rankin Inlet se situe à proximité de trois autres collectivités. En effet, Chesterfield Inlet, Whale Cove et Arviat étant toutes situées à moins de 100 NM; les navigateurs de chacune de ces quatre collectivités pourront profiter des services de la station d'ESC de Rankin Inlet.

Cet emplacement obtient également le solide appui du Bureau de gestion des urgences du gouvernement du Nunavut.

Tableau 1 – Zones de recherche et de sauvetage dans l'Arctique

010	Est de l'Arctique (RRS d'Halifax)
155	Baie d'Hudson et baie James
259	Totalité des terres et des eaux des Territoires du Nord-Ouest
260	Totalité des terres et des eaux du Nunavut, sauf les eaux des régions d'Hudson et de la baie James

Figure 1 – Carte des zones de recherche et de sauvetage dans l'Arctique

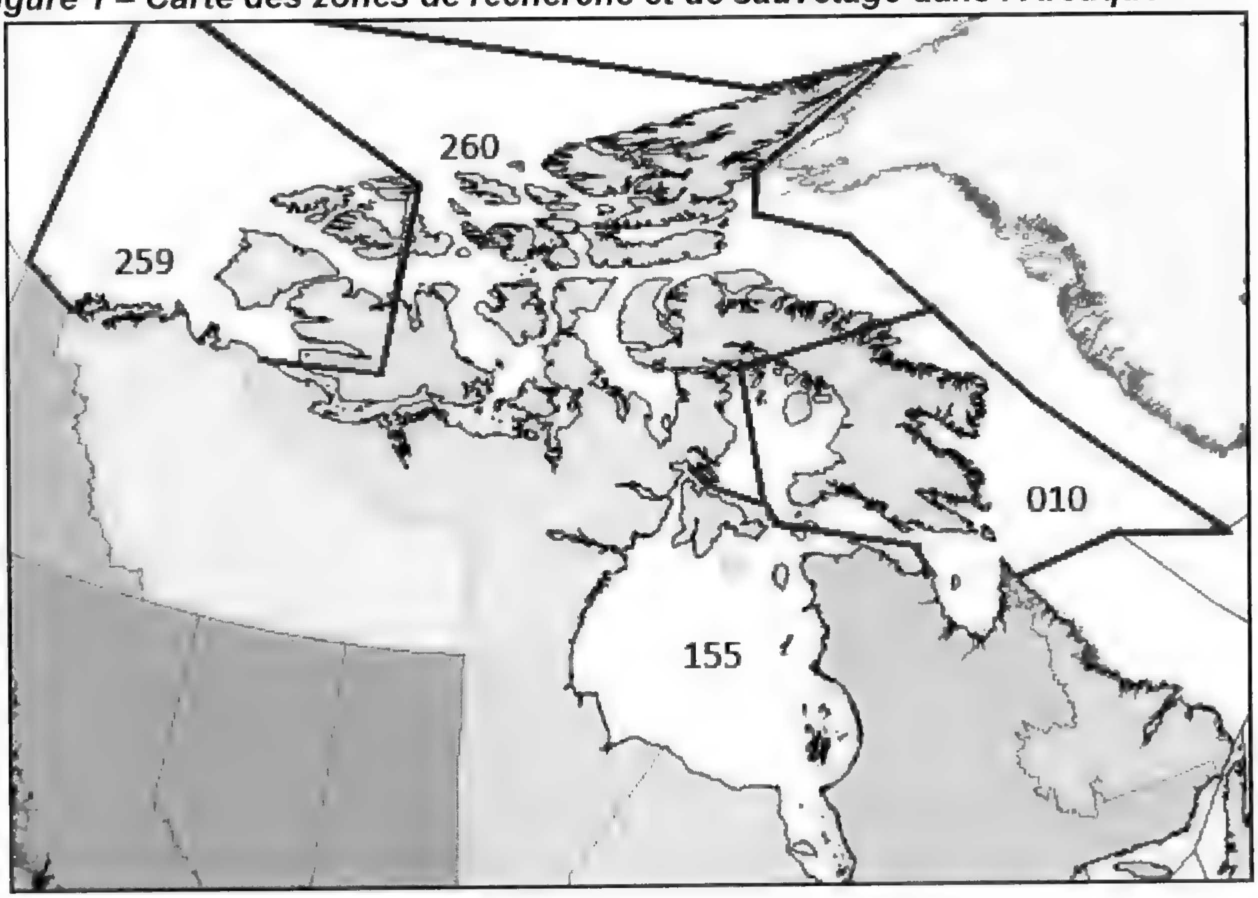


Tableau 2 – Facteurs et descriptions par catégorie

	Facteurs et descriptions – Analyse des risques RAMSARD	
	Facteur	Description
Population et activité nautique	Population	Plus de personnes = risque plus élevé
	Nombre de bateaux	Plus de bateaux dans la zone = risque plus élevé
	Taille des bateaux	Bateaux de petite taille (moindre navigabilité) = risque plus élevé
	Intensité de l'activité nautique	Beaucoup d'activité et distances éloignées = risque plus élevé
	Intensité de l'industrie maritime	Beaucoup d'activité = risque plus élevé
	Saison de navigation	Saison plus longue = risque plus élevé
Géographie/ environnement	Eau	Marées, courants et hauts-fonds = risque plus élevé
	Glaces durant la saison	Glace dynamique et persistante = risque plus élevé
	Brouillard	Zone propice au brouillard = risque plus élevé
	Vents	Conditions locales extrêmes = risque plus élevé
	Critères géographiques	Pas de havre sûr à proximité = risque plus élevé
Soutien de R et S	Autres ressources de R et S	Pas de GCC/ARC/ACRSA = risque plus élevé
	Capacité locale de R et S	Aucune capacité = risque plus élevé
	Statistiques historiques de R et S	Chiffres élevés = risque plus élevé
	Communications	Absence de SCTM ou de canal VHF local = risque plus élevé

Annexe B

	Facteurs et descriptions – Propension de la collectivité à établir une unité auxiliaire*	
	Facteur	Description
Facteurs sociaux et infrastructure	Appui/enthousiasme	Niveau d'appui/enthousiasme du Conseil et de la collectivité
	Sécurité	Niveau de sécurité des employés et des atouts
	Accès au transport	Disponibilité de pistes d'atterrissage en bon état facilitant les voyages
	Infrastructure	Disponibilité d'une jetée ou d'un quai en bon état pour le ou les navires
	Services	Disponibilité d'un soutien médical/de services de mécanique
Disponibilité de navires	Taille des bateaux	L'unité auxiliaire a besoin d'un plus grand navire
	État des bateaux	L'unité auxiliaire a besoin d'un navire en bon état
	Nombre de bateaux	Nombre de bateaux parmi lesquels peut choisir l'unité auxiliaire
	*Pour ces facteurs, un meilleur classement indique une plus grande propension à mettre sur pied une unité auxiliaire.	

Tableau 3 – Descriptions du classement (faible, moyen, élevé) par facteur

	Analyse des risques RAMSARD			
	Facteur	Cote faible (1)	Cote moyenne (2)	Cote élevée (3)
Population et activité nautique	Population	Moins de 500	Entre 500 et 1500	Plus de 500
	Nombre de bateaux	Moins de 25	Entre 25 et 75	Plus de 75
	Taille des bateaux	Grand (plus de 26 pieds)	Moyen (entre 18 et 26 pieds)	Petit (entre 16 et 18 pieds)
	Intensité de l'activité nautique	Activité de faible niveau (locale)	À une certaine distance des camps	En transit vers des camps éloignés
	Intensité de l'industrie maritime	Subsistance locale seulement	Pêches commerciales locales, tourisme	Activités externes – exploitation minière
	Durée de la saison de navigation	Fin juillet à mi-septembre	Mi-juin à fin octobre	Début juin à fin octobre
Géographie/environnement	Eau	Marées/courants minimaux	Marées de 6 à 10 pieds	Marées supérieures à 10 pieds
	Glaces durant la saison	Dispersion des glaces, aucun risque d'embâcle	Certains mouvements des glaces et certains embâcles	Non-dispersion des glaces, embâcles fréquents
	Brouillard	Peu de problèmes de brouillard	En fonction de la météo	Risque de brouillard fréquent
	Vents	Vents associés aux orages/zones de basse pression	Vents dominants saisonniers	Vents forts, prévisibles et fréquents
	Critères géographiques	Eaux entourées d'îlots, de baies et de havres	Îles, îlots et baies à proximité	Eau libre et côtes aux conditions difficiles
Soutien de R et S	Autres ressources de R et S	Proximité d'un poste de l'ACRSA ou de l'ARC (corridor de navigation)	Proximité de ressources aériennes et de corridors de navigation	Aucune ressource aérienne et éloignement des corridors de navigation
	Capacité locale de R et S	Unité de R et S opérationnelle	Faible unité de la GCAC ou de R et S	Aucune unité de la GCAC ni capacité locale
	Statistiques historiques de R et S	Moins de 5 sur une période de 5 ans	5 sur une période de 5 ans	Plus de 5 sur une période de 5 ans
	Communications	Possède un SCTM et un canal VHF local	Possède un SCTM ou un canal VHF local	Aucun SCTM ou canal VHF local

Annexe B

	Propension de la collectivité à établir une unité auxiliaire*			
	Facteur	Cote faible (1)	Cote moyenne (2)	Cote élevée (3)
Facteurs sociaux et infrastructure	Appui /Enthousiasme	Aucun intérêt d'être membres de la GCAC ni soutien du Conseil	Affiche un certain appui	Appui enthousiaste du Conseil et de la population
	Sécurité**	Taux de criminalité élevé / sécurité faible	Taux de criminalité moyen / sécurité moyenne	Taux de criminalité bas/ sécurité élevée
	Accès au transport	Courte piste de gravier	Longue piste de gravier	Longue piste pavée
	Infrastructure maritime	Juste une plage	Rampe de mise à l'eau ou quai flottant	Ouvrage longitudinal, petite jetée
	Services	Infirmerie seulement	Centre médical (garage)	Hôpital, industrie lourde
Disponibilité de navires	Taille des bateaux	Petit (entre 16 et 18 pieds)	Moyen (entre 18 et 26 pieds)	Grand (plus de 26 pieds)
	État des bateaux	Coque ou gréements endommagés, aucun équipement de sécurité	Coque en bon état, systèmes fonctionnels, équipement de sécurité partiel	Coque en bon état, systèmes fonctionnels, équipement de sécurité complet, radio
	Nombre de bateaux	Moins de 25	Entre 25 et 75	Plus de 75

*Pour ces facteurs, un meilleur classement indique une plus grande propension à accueillir une unité auxiliaire.
** Ce facteur était déterminant pour la recommandation de l'emplacement de la station d'ESC.

Tableau 4 – Région d'Inuvialuit (Territoires du Nord-Ouest)

	Analyse RAMSARD – Classements du facteur de risque						
	Facteur	**Inuvik**	**Aklavik**	**Tuktoyaktuk**	**Sachs Harbour**	**Ulukhaktok**	**Paulatuk**
Population et activité nautique	Population	3	2	2	1	1	1
	Nombre de bateaux	3	2	2	1	2	2
	Taille des bateaux	2	3	2	3	3	3
	Intensité de l'activité nautique	1	1	2	1	2	2
	Intensité de l'industrie maritime	3	1	2	1	1	1
	Durée de la saison de navigation	2	1	2	2	2	2
Géographie/ environnement	Eau	1	1	1	1	1	1
	Glaces durant la saison	1	1	1	1	1	1
	Brouillard	1	1	2	1	1	1
	Vents	1	1	2	2	2	2
	Critères géographiques	1	1	3	3	2	2
Soutien de R et S	Autres ressources de R et S	1	2	2	3	3	3
	Capacité locale de R et S	1	2	1	3	3	3
	Statistiques historiques de R et S	2	2	2	1	1	1
	Communications	2	1	1	3	3	3
	Totaux	**25**	**22**	**27**	**27**	**28**	**28**

Annexe B

	Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire						
	Facteur	Inuvik	Aklavik	Tuktoyaktuk	Sachs Harbour	Ulukhaktok	Paulatuk
Facteurs sociaux et infrastructure	Appui/enthousiasme	3	1	3	1	3	2
	Sécurité	2	3	3	3	3	3
	Accès au transport	3	1	2	1	1	1
	Infrastructure maritime	3	1	2	1	1	1
	Services	3	1	2	1	1	1
Disponibilité des navires	Taille des bateaux	2	3	2	3	3	3
	État des bateaux	1	1	1	1	1	1
	Nombre de bateaux	3	1	1	1	1	1
	Totaux	**20**	**12**	**16**	**12**	**14**	**13**

Tableau 5 – Région de Kitikmeot (Nunavut)

	Analyse RAMSARD – Classements du facteur de risque					
	Facteur	**Kuugaruk**	**Taloyoak**	**Gjoa Haven**	**Cambridge Bay**	**Kugluktuk**
Population et activité nautique	Population	2	2	3	3	3
	Nombre de bateaux	1	1	1	2	2
	Taille des bateaux	3	3	3	2	2
	Intensité de l'activité nautique	1	2	2	2	2
	Intensité de l'industrie maritime	1	1	3	3	2
	Durée de la saison de navigation	2	2	2	2	2
Géographie/ environnement	Eau	2	2	1	1	1
	Glaces durant la saison	2	2	2	2	1
	Brouillard	2	2	2	2	2
	Vents	2	1	1	1	1
	Critères géographiques	1	1	1	1	1
Soutien de R et S	Autres ressources de R et S	3	3	3	3	3
	Capacité locale de R et S	3	3	3	1	1
	Statistiques historiques de R et S	1	1	1	1	1
	Communications	3	3	3	2	3
	Totaux	**29**	**29**	**31**	**28**	**27**

Annexe B

Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire

	Facteur	Kuugaruk	Taloyoak	Gjoa Haven	Cambridge Bay	Kugluktuk
Facteurs sociaux et infrastructure	Appui/enthousiasme	2	2	3	3	3
	Sécurité	2	3	2	3	3
	Accès au transport	2	2	2	1	2
	Infrastructure	1	1	2	3	2
	Services	2	2	2	3	2
Disponibilité des navires	Taille des bateaux	1	1	1	2	2
	État des bateaux	1	1	1	2	2
	Nombre de bateaux	1	1	1	2	2
	Totaux	**12**	**13**	**14**	**19**	**18**

Tableau 6 – Région de Kivalliq (Nunavut)

	Analyse RAMSARD – Classements du facteur de risque							
	Facteur	**Arviat**	**Whale Cove**	**Rankin Inlet**	**Chesterfield Inlet**	**Naujaat**	**Coral Harbour**	**Baker Lake***
Population et activité nautique	Population	2	2	3	3	3	3	3
	Nombre de bateaux	2	2	3	2	2	2	Inconnu
	Taille des bateaux	3	3	2	3	2	3	Inconnu
	Intensité de l'activité nautique	3	3	3	3	2	2	Inconnu
	Intensité de l'industrie maritime	1	1	3	3	2	3	2
	Durée de la saison de navigation	2	2	2	2	2	2	2
Géographie/ environnement	Eau	2	2	2	2	2	2	2
	Glaces durant la saison	2	2	2	2	2	2	2
	Brouillard	2	2	2	2	2	2	Inconnu
	Vents	2	2	2	2	2	2	Inconnu
	Critères géographiques	1	1	2	2	1	2	1
Soutien de R et S	Autres ressources de R et S	2	2	2	2	2	2	2
	Capacité locale de R et S	3	3	3	3	2	3	Inconnu
	Statistiques historiques de R et S	2	2	2	2	2	2	Inconnu
	Communications	3	3	3	3	3	3	3
	Totaux	**32**	**32**	**36**	**36**	**31**	**35**	**17**

Annexe B

Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire								
	Facteur	**Arviat**	**Whale Cove**	**Rankin Inlet**	**Chesterfield Inlet**	**Naujaat**	**Coral Harbour**	**Baker Lake***
Facteurs sociaux et infrastructure	Appui/enthousiasme	2	1	2	2	2	2	Inconnu
	Sécurité	3	3	2	3	3	3	1
	Accès au transport	2	1	3	1	1	1	1
	Infrastructure maritime	2	1	3	1	2		2
	Services	2	1	3	1	2	2	2
Disponibilité des navires	Taille des bateaux	1	1	2	1	1	1	Inconnu
	État des bateaux	1	1	1	1	1	1	2
	Nombre de bateaux	1	1	3	1	1	1	Inconnu
	Totaux	**14**	**10**	**19**	**11**	**13**	**11**	**8**

* Baker Lake ne se trouve pas dans les eaux relevant de la compétence de la Garde côtière en matière de R et S et n'est donc pas admissible à une unité auxiliaire.

Tableau 7 – Région de Qikiqtaaluk (Nunavut)

Analyse RAMSARD – Classements du facteur de risque

	Facteur	Iqaluit	Pangnirtung	Qikiqtarjuaq	Clyde River	Pond Inlet	Arctic Bay	Cape Dorset	Kimmirut	Sanikiluaq	Igloolik	Hall Beach	Fjord Grise	Resolute
Population et navigation	Population	3	2	2	2	2	1	2	1	3	2	2	3	3
	Nombre de bateaux	3	2	2	2	2	3	2	2	2	2	2	1	2
	Taille des bateaux	2	2	2	2	2	2	3	3	3	2	2	3	3
	Intensité de l'activité nautique	3	2	2	2	3	3	3	2	2	3	3	1	1
	Intensité de l'industrie maritime	3	3	1	1	2	1	1	1	1	1	1	1	2
	Durée de la saison de navigation	2	2	2	2	2	2	3	2	2	2	2	1	1
Géographie/ environnement	Eau	3	3	2	2	2	1	2	2	1	2	2	3	3
	Glaces durant la saison	2	2	1	1	2	2	1	1	1	2	2	3	3
	Brouillard	2	2	1	1	2	2	1	1	2	2	2	2	2
	Vents	2	3	2	2	2	2	2	2	2	2	2	3	3
	Critères géographiques	2	3	2	2	2	2	3	2	2	2	2	2	2
Soutien R et S	Autres ressources de R et S	2	3	3	3	3	3	3	3	3	3	3	3	1
	Capacité locale de R et S	2	1	3	3	3	3	3	3	3	3	3	3	3
	Statistiques historiques de R et S	2	2	2	2	3	3	2	2	2	2	2	2	2
	Communications	1	2	3	2	3	3	3	3	3	3	3	2	2
	Totaux	**34**	**34**	**30**	**29**	**35**	**33**	**34**	**30**	**32**	**33**	**33**	**33**	**33**

Addenda (Station d'ESC du Nord – emplacement recommandé)

Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire

	Facteur	Iqaluit	Pangnirtung	Qikiqtarjuaq	Clyde River	Pond Inlet	Arctic Bay	Cape Dorset	Kimmirut	Sanikiluaq	Igloolik	Hall Beach	Fjord Grise	Resolute
Facteurs sociaux et infrastructure	Appui/enthousiasme	2	3	3	3	3	3	2	3	2	3	3	2	2
	Sécurité	2	3	3	3	3	3	1	3	3	3	3	3	3
	Accès au transport	3	2	2	2	2	2	2	1	1	2	2	1	3
	Infrastructure maritime	3	3	2	1	1	1	1	1	1	1	1	1	1
	Services	3	2	2	2	2	1	2	1	1	2	2	1	1
Navires	Taille des bateaux	2	2	1	1	2	1	2	1	1	2	2	1	1
	État des bateaux	2	2	1	1	2	1	1	1	1	1	1	1	1
	Nombre de bateaux	3	2	1	1	2	1	2	1	1	2	2	1	1
	Totaux	**20**	**19**	**15**	**14**	**17**	**13**	**13**	**12**	**11**	**16**	**16**	**11**	**13**

Tableau 8 – Région de la baie d'Hudson (Nunavik)

	Analyse RAMSARD – Classements du facteur de risque						
	Facteur	**Ivujivik**	**Akulivik**	**Puvirnituq**	**Inukjuak**	**Umiujaq**	**Kuujjuarapik**
Population et activité nautique	Population	1	2	3	3	1	2
	Nombre de bateaux	2	2	2	2	2	2
	Taille des bateaux	1	1	1	1	1	1
	Intensité de l'activité nautique	2	2	2	2	2	2
	Intensité de l'industrie maritime	1	1	1	1	1	1
	Durée de la saison de navigation	2	2	2	2	2	2
Géographie/ environnement	Eau	2	2	2	2	2	2
	Glaces durant la saison	2	2	2	2	2	2
	Brouillard	2	2	2	2	2	2
	Vents	2	2	2	2	2	2
	Critères géographiques	2	2	2	2	2	2
Soutien de R et S	Autres ressources de R et S	1	1	1	1	1	1
	Capacité locale de R et S	3	3	3	3	3	3
	Statistiques historiques de R et S	1	1	1	1	1	1
	Communications	3	3	3	3	3	3
	Totaux	**27**	**28**	**29**	**29**	**27**	**28**

Addenda (Station d'ESC du Nord – emplacement recommandé)

Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire

	Facteur	**Ivujivik**	**Akulivik**	**Puvirnituq**	**Inukjuak**	**Umiujaq**	**Kuujjuarapik**
Facteurs sociaux et infrastructure	Appui/enthousiasme	2	2	2	2	2	2
	Sécurité	2	2	2	2	2	2
	Accès au transport	2	2	1	2	2	2
	Infrastructure maritime	2	2	2	2	2	2
	Services	1	2	3	3	1	2
Disponibilité des navires	Taille des bateaux	1	1	1	1	1	1
	État des bateaux	1	1	1	1	1	1
	Nombre de bateaux	2	2	2	2	2	2
	Totaux	**13**	**14**	**14**	**15**	**13**	**14**

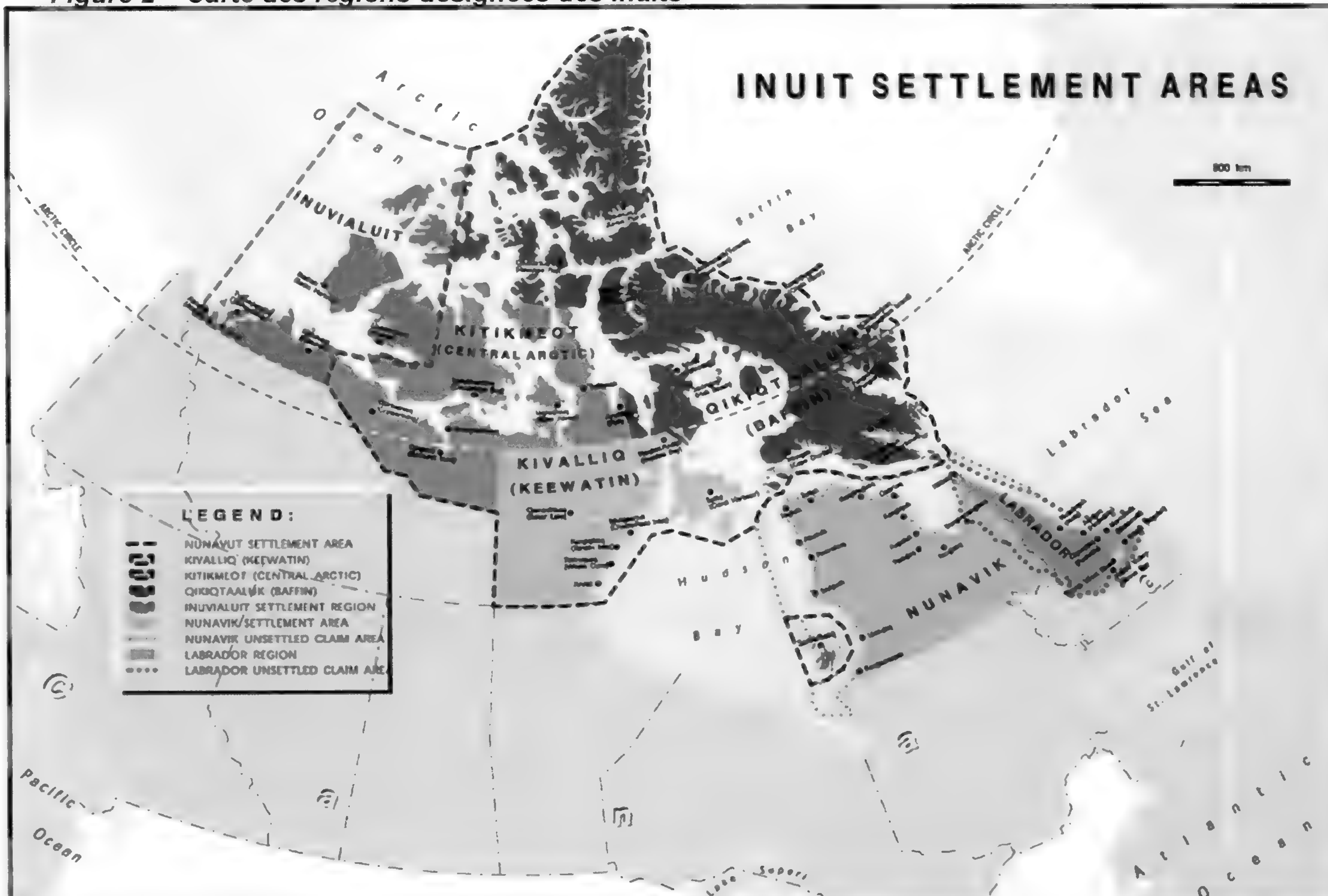
Tableau 9 – Région du détroit d'Hudson et de la baie d'Ungava (Nunavik)

	Analyse RAMSARD – Classements du facteur de risque								
	Facteur	Kuujjuaq	Kangiqsualujjuaq	Tasiujaq	Aupaluk	Kangirsuk	Quaqtaq	Kangiqsujuaq	Salluit
Population et navigation	Population	3	1	1	1	2	1	2	3
	Nombre de bateaux	2	1	1	1	2	1	2	2
	Taille des bateaux	1	1	1	1	1	1	1	1
	Intensité de l'activité nautique	2	2	2	2	2	2	2	2
	Intensité de l'industrie maritime	2	1	1	1	1	1	1	2
	Durée de la saison de navigation	2	2	2	2	2	2	2	2
Géographie/ environnement	Eau	3	3	2	2	3	2	3	3
	Glaces durant la saison	3	3	3	3	3	3	3	3
	Brouillard	2	2	2	2	2	2	2	2
	Vents	2	2	2	2	2	2	2	2
	Critères géographiques	2	2	2	2	2	2	2	2
Soutien de R et S	Autres ressources de R et S	3	3	3	3	3	3	3	3
	Capacité locale de R et S	2	2	2	2	2	2	2	2
	Statistiques historiques de R et S	1	1	1	1	1	1	1	1
	Communications	3	3	3	3	3	3	3	3
	Totaux	**33**	**29**	**28**	**28**	**31**	**28**	**31**	**33**

Annexe B

	Classements par facteur de la propension d'une collectivité à établir une unité auxiliaire								
	Facteur	**Kuujjuaq**	**Kangiqsualujjuaq**	**Tasiujaq**	**Aupaluk**	**Kangirsuk**	**Quaqtaq**	**Kangiqsujuaq**	**Salluit**
Facteurs sociaux et infrastructure	Appui/enthousiasme	3	3	3	3	3	3	3	3
	Sécurité	2	2	2	2	2	2	2	2
	Accès au transport	3	2	2	2	2	2	2	2
	Infrastructure maritime	3	3	3	3	3	3	3	3
	Services	3	2	2	2	2	2	2	3
Navires	Taille des bateaux	1	1	1	1	1	1	1	1
	État des bateaux	1	1	1	1	1	1	1	1
	Nombre de bateaux	2	1	1	1	2	1	2	2
	Totaux	**18**	**15**	**15**	**15**	**16**	**15**	**16**	**17**

Figure 2 – Carte des régions désignées des Inuits



Government of Canada | Gouvernement du Canada
Fisheries and Oceans | Pêches et Océans

EKME # 3879568

To:
Pour: Greg Lick GL 13/02

Date:

Object:

Approval of recommended Search and Rescue areas undergoing a Risk Based Analysis of Maritime Search and Rescue Delivery (RAMSARD) in 2018-19.

From / De:

Sheyla Dussault, Manager SAR – Project Leader RAMSARD SD

Via: Derek Moss, Director Incident Management – Project Director RAMSARD

X	Your Signature Votre signature		Information
	For Comments Observations		Material for the Minister Documents pour le ministre

Drafting Officer/ Rédacteur: Yasmine Clarke, Project Manager RAMSARD 613-851-8275

Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Coast Guard | Garde côtière canadienne

UNCLASSIFIED

EKME # 3879568

MEMORANDUM FOR THE DIRECTOR GENERAL OF OPERATIONS

APPROVAL OF RECOMMENDED SEARCH AND RESCUE AREAS UNDERGOING A RISK BASED ANALYSIS OF MARITIME SEARCH AND RESCUE DELIVERY (RAMSARD) REVIEW IN 2018-19

(Decision Sought / Signature Required)

SUMMARY

- 2018/19 Fiscal Year will mark the first cycle of the ***national*** implementation of the RAMSARD Methodology.
- Limited areas are being reviewed in 2018-19 (1 per Region) to allow the review of the methology and tool refinement.
- Recommended areas have been approved by each Assistant Commissioner.
- Proposed areas includes: Labrador Coast – Area 009, Kingston to Cornwall – Area 110, all of Arctic – Areas 260,259,155 and 010, North Coast BC – Area 306.
- It is recommended to approve proposed Search and Rescue (SAR) areas to undergo a RAMSARD review in 2018-19.

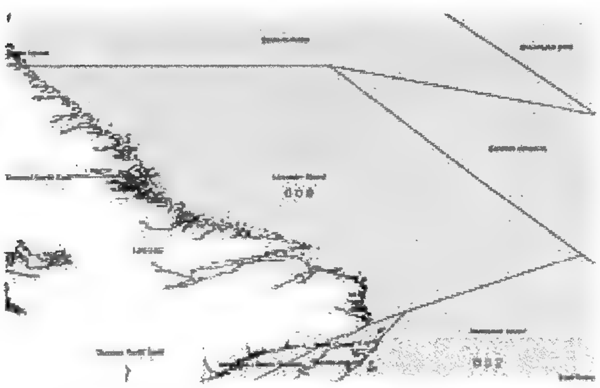
Background

As part of the Oceans Protection Plan, The Canadian Coast Guard is implementing its Risk-Based Analysis of Maritime Search and Rescue Delivery (RAMSARD) methodology nationally which will address Pillar I of the Oceans Protection Plan – State of the art marine safety system. RAMSARD will assist the Coast Guard in proactively identifying SAR areas with new or emerging marine risks and ultimately ensure a more systematic approach to evaluating maritime SAR delivery in Canada. This review process is intended to be the SAR program planning tool and, once fully implemented, will result in improved SAR planning, decision-making and ultimately marine safety. This will allow the Coast Guard to understand marine risks better, implement mitigation measures within our control and recommend measures to other agencies responsible for carriage requirements and prevention activities.

2018/19 Fiscal Year will mark the first cycle of the national implementation of the RAMSARD Methodology (methodology review + tool refinement = only 1 per Region in 2018-19).

Analysis / DFO Comment

Labrador Coast – Area 009



The Labrador Coast is being recommended for the following reasons:

- Area is seeing an increase in marine traffic which includes: pleasure craft, ecotourism, oil & gas industry, and cruise line industry.

- The creation of Torngat Mountains National Park in July 2008 is bringing a steady increase of visitors each year.

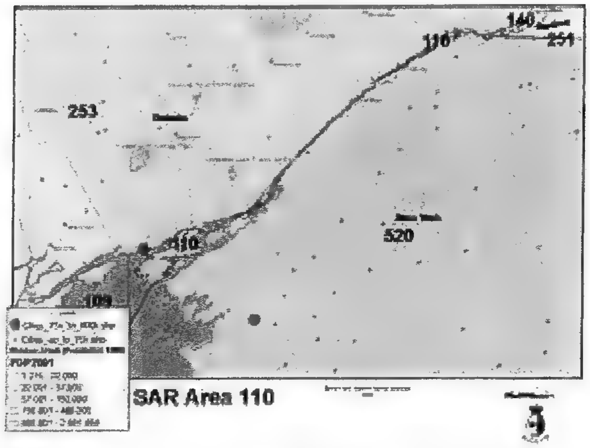
- A SAR needs analysis has not been conducted in many years (+10 years).

- It is adjacent to the RAMSARD review taking place in the Eastern Arctic. It will be beneficial to allow both CG Regions to consult together with interested parties that border the two CG regions. The Atlantic RAMSARD team will work closely with the C&A Arctic RAMSARD team where engagement falls within the Halifax Search and Rescue Region.

s.21(1)(b)

Central:

Kingston to Cornwall – Area 110



Following consultations with the JRCC Trenton and MRSC Quebec RSMSs, as well as with the CCGA- C&A Operations Director, RAMSARD 110, Kingston to Cornwall, is recommended for the following reasons:

- Maritime SAR 110 covers from Kingston to Cornwall over a distance of 100 NM, including the Thousand Islands Hotspots and the Akwesasne Native Reserve in the Cornwall area.

- Following a City Council decision in 2017, the maritime unit of the Morrisburg City Fire Department has ceased its nautical activities. They were also members of the CCGA.

- Maritime SAR coverage of the Prescott section in Cornwall is virtually non-existent.

- JRCC Trenton must often fall back on the maritime units of the OPP and RCMP police services that are involved in SAR operations, but this is not the primary mandate.

- The Coast Guard Auxiliary has only one operational unit in Area 110 at Brockville. However, this will be their last operational season in 2018.

- Considering certain illegal activities in the Cornwall area, SAR operations can be risky or even dangerous for either the Coast Guard or any other organization wishing to participate in the Maritime SAR Program in this area.

- [redacted]

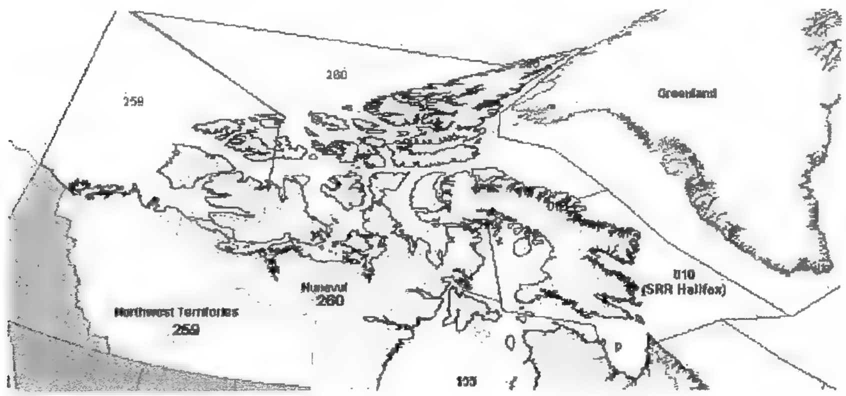
- Area 110 west of Brockville is covered by an IRB operating from Hill Island from May to early September covering all Thousand Islands. There is a 47' SAR station in Kingston.

- From spring to fall, sector 110 from Kingston to Cornwall is busy with recreational boating and cruising, as well as intense commercial sea shipping. The number of SAR cases is high and

maritime coverage by SAR units is constantly decreasing. A RAMSARD analysis of this sector would provide a better appreciation of the situation.

Arctic:

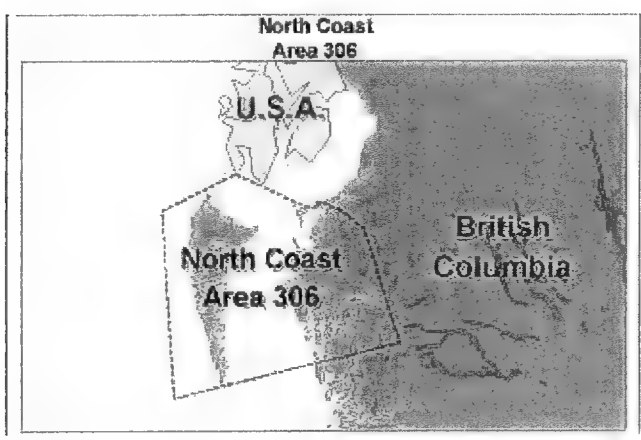
All of Arctic: 260,259,155 and 010.



- Arctic is recommended to be evaluated as a whole since the primary goal of the next Arctic RAMSARD is to evaluate risk and calculate priorities to support decisions concerning the implementation of CCGA units in the Arctic and other OPP initiatives.

Western:

North Coast BC - 306



- North Coast BC area is recommended to be reviewed in order to evaluate risk and support decisions concerning the implementation of CCGA units in British Columbia and other important OPP initiatives such as the Indigenous Community Response Training and Towing.

- The risk-analysis will also provide valuable information in the development of the new Regional Response plans as part of the Regional Response Planning (RRP) OPP project, and support the next Mass Rescue exercise on the West Coast in September 2019.

.../2

Recommendations / Next Steps

- It is recommended to approve the proposed Search and Rescue areas to undergo a RAMSARD review in 2018-19.

Sheyla Dussault, Manager Search and Rescue

I concur,
Greg Lick
Director General Operations

Smith, Laura (SAR)

From:	Clarke, Yasmine
Sent:	August-02-18 2:36 PM
To:	Evans, Clay; Bourdon, Jean; Garapick, Peter; Vardy, Harvey
Cc:	Dussault, Sheyla; Allison, Steve; Dantzler-Hill, Hannah; Elvidge, Krista; Labatt, Sylvain; Landry, Jean-Sebastien; McClelland, Melinda; Nyren, Richard
Subject:	Draft Five Year Assessment Plan for RAMSARD
Attachments:	Five Year Assessment Plan RAMSARD July 2018.docx

Good afternoon Sups,

Please find enclosed the draft Five Year Assessment Plan for the Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) Project.

The 5 year assessment plan outlines the process for annual selection of the areas to undergo a review as well as the authorities for the selection. It also provides the regional distributions of areas.

Please review, confirm the regional distribution of areas and inform of any changes or comments you may have.

Please note that area 010 is assigned to CA however it must be reviewed in consultation with JRCC Halifax (ATL) and area 200 is assigned to Western however it must be reviewed in consultation with JRCC Trenton (CA).

Thank you,

Yasmine Clarke
SAR OPS Analyst / Analyste aux Opérations R&S
Project Manager Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) I Gestionnaire de projet pour RAMSARD
Incident Management, Search and Rescue I Gestion des incidents, Recherche et sauvetage
Canadian Coast Guard Operations I Garde côtière canadienne Opérations
200 Kent Street, Ottawa, Ontario K1A 0E6
5E204
BB: [redacted]

s.16(2)

Five Year Assessment Plan for the Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) Project.

Under the RAMSARD framework, the 40 Coast Guard (CG) sub-areas within the three Search and Rescue Regions (SRR) are assessed continuously over a five-year cycle using resources and methodologies outlined in the RAMSARD Manual.

Process for annual selection of areas:

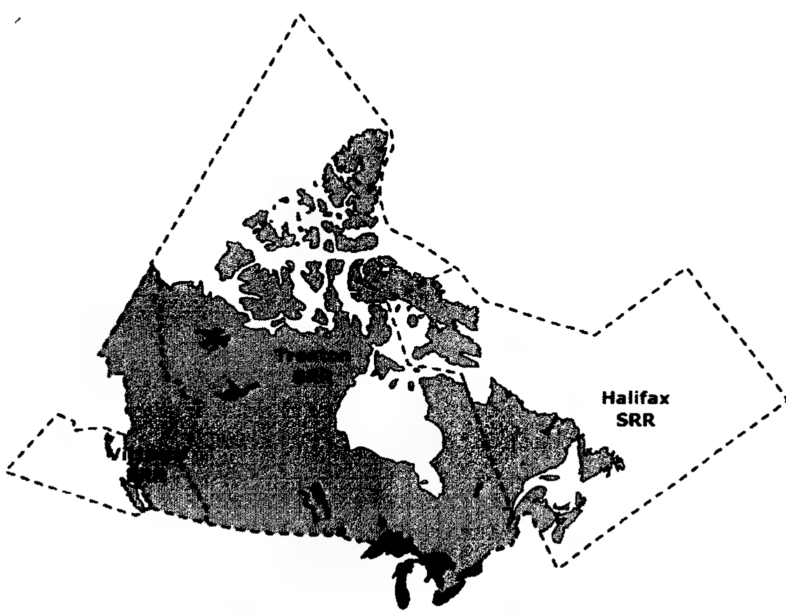
1. Annual selection of SAR areas to undergo a RAMSARD review will be based primarily on Regional priorities. i.e. adverse weather, proximity to marine hazards, uncharted waters, increase trend in marine distress calls, increase in marine traffic, request from industry, change in SAR assets, etc.
2. All SAR areas within each Region will be reviewed once annually on a five-year cycle. This will require multiple area reviews in any given year. i.e. two adjacent areas assessed simultaneously.

Authorities for annual selection of areas:

1. Regional Superintendents SAR in consultation with the Manager, SAR in HQ will recommend SAR areas to undergo a review through the Regional Directors, Incident Management.
2. Assistant Commissioners will endorse SAR areas to undergo a review.
3. Director General, Operations will approve SAR areas to undergo a review.

Areas of Responsibilities:

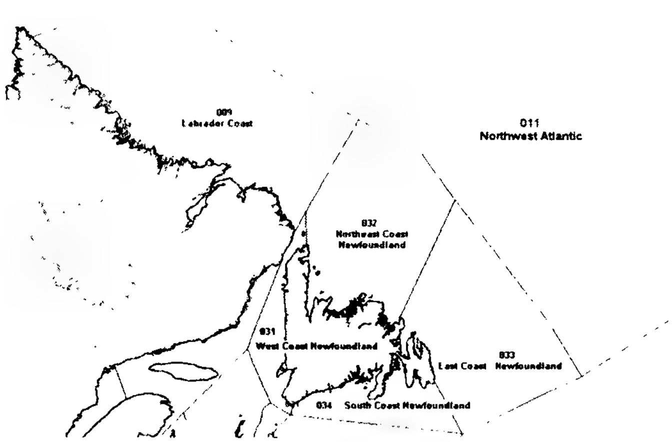
SRR Regions:

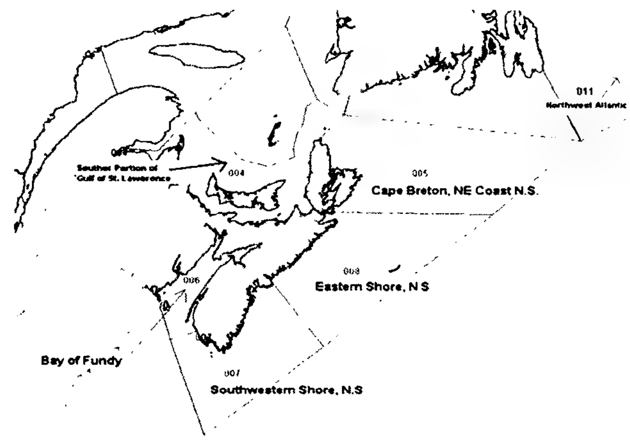


Atlantic:

Atlantic is responsible for the review of 11 of the 40 Search and Rescue Areas.

1	004 Gulf of St. Lawrence - Southern Portion
2	005 Cape Breton (N.S.) (North East Coast)
3	006 Bay of Fundy (N.S.)
4	007 Southwestern Shore (N.S.)
5	008 Eastern Shore (N.S.)
6	009 Labrador Coast
7	011 Northwest Atlantic
8	031 West Coast (Nfld.)
9	032 North East Coast (Nfld.)
10	033 East Coast (Nfld.)
11	034 South Coast (Nfld)



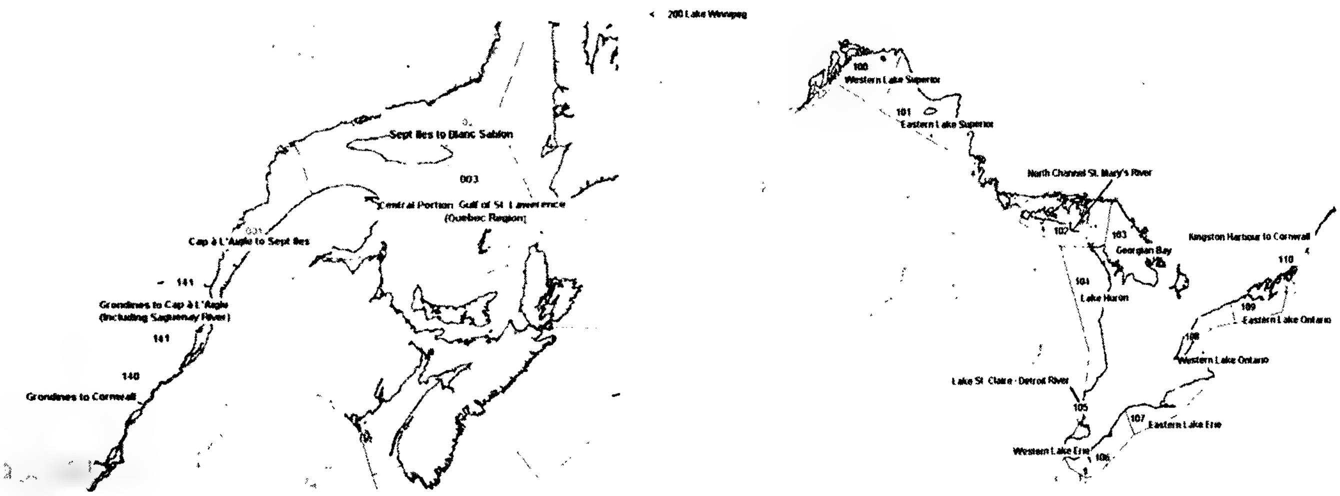


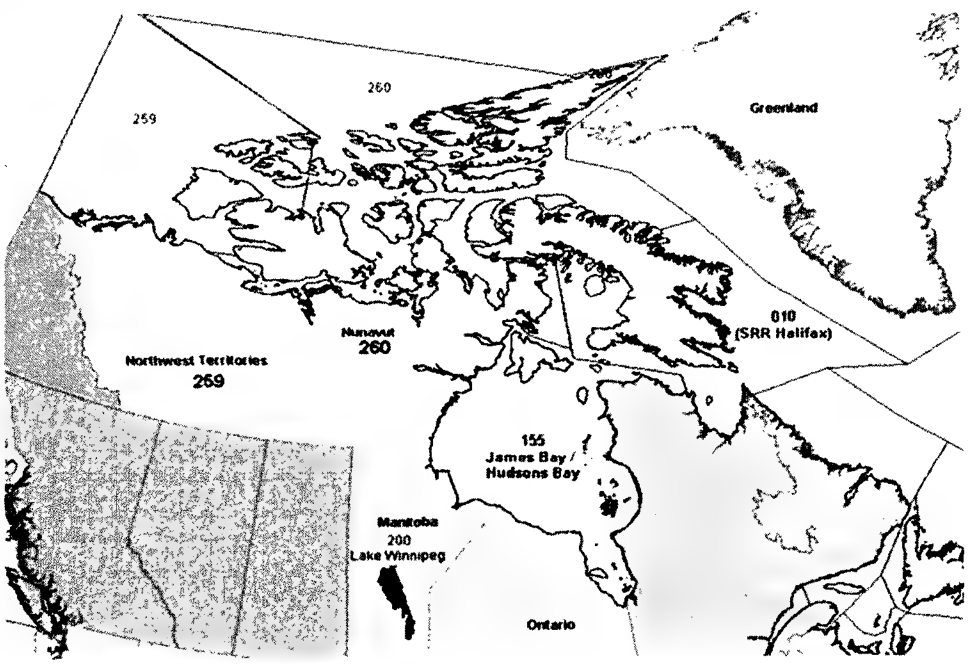
Central and Arctic:

C&A is responsible for the review of 20 of the 40 Search and Rescue Areas.

1	001 Cap à L'Aigle to Sept Îles
2	002 Sept-Îles to Blanc Sablon (including Gaspésie)
3	003 Gulf of St. Lawrence – Central Portion (including Îles de la Madeleine)
4	140 Cornwall to Grondines
5	141 Grondines to Cap à L'Aigle (Saguenay River included)
6	100 Western Lake Superior
7	101 Eastern Lake Superior
8	102 North Channel St. Mary's River
9	103 Georgian Bay
10	104 Lake Huron
11	105 Lake St. Claire/Detroit River
12	106 Western Lake Erie
13	107 Eastern Lake Erie
14	109 Eastern Lake Ontario
15	108 Western Lake Ontario
16	110 Kingston harbour to Cornwall

17	259 All lands and waters of the Northwest Territories * Description of SAR Area 259 revised Feb 2006.
18	155 Hudson Bay - James Bay
19	260 All lands and water areas of Nunavut except the water areas of Hudson and James Bays. Note: Islands in Hudson Bay & James Bay are lands of Nunavut. * Description of SAR Area 259 revised Feb 2006
20	010 Eastern Arctic *In consultation with JRCC Halifax

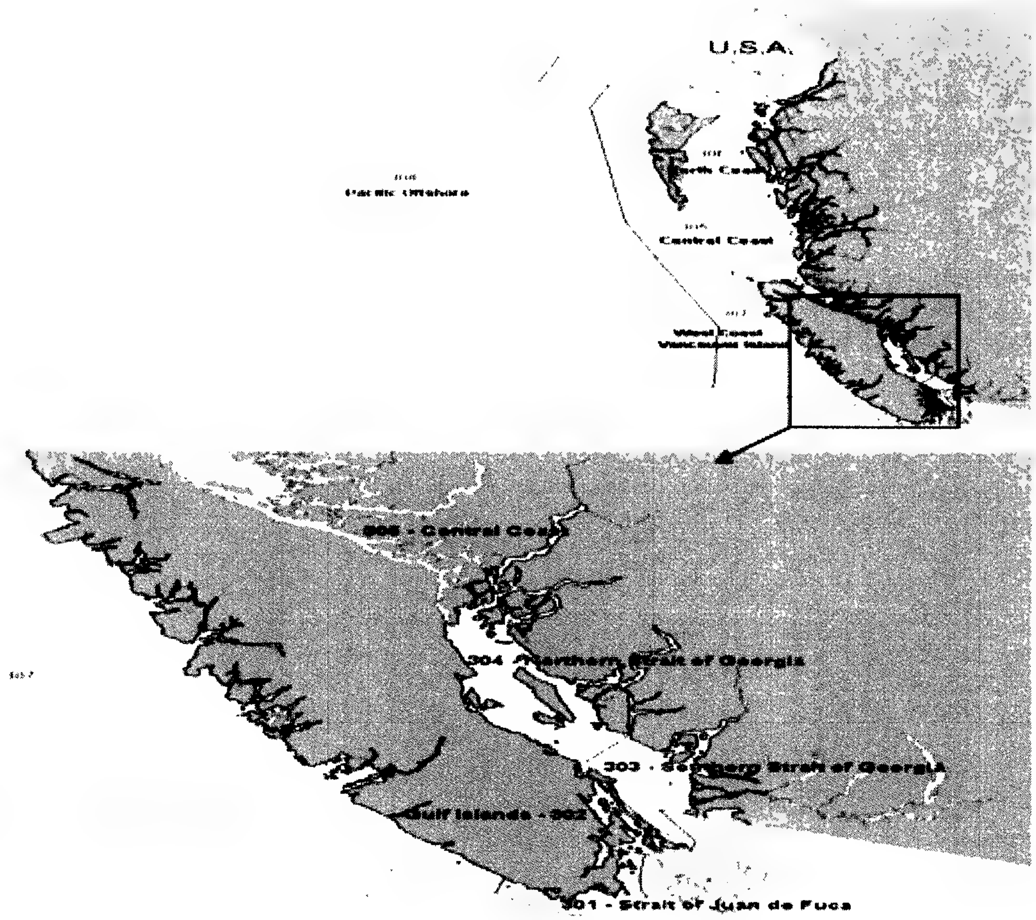




Western:

West is responsible for the review of 9 of the 40 Search and Rescue Areas.

1	200 Lake Winnipeg *In consultation with JRCC Trenton
2	301 Strait of Juan de Fuca (B.C.)
3	308 Pacific Offshore
4	302 Gulf Islands (B.C.)
5	303 Southern Strait of Georgia (B.C.)
6	304 Northern Strait of Georgia (B.C.)
7	305 Central Coast (B.C.)
8	306 North Coast (B.C.)
9	307 West Coast Vancouver Island



First National RAMSARD Cycle - 2018-19 to 2022-23

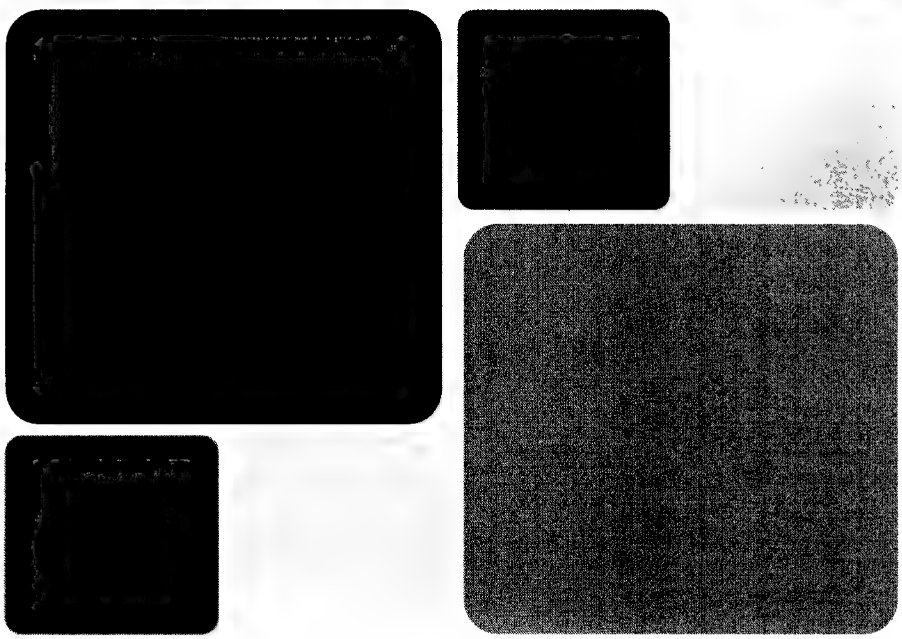
Fiscal Year	Region	Area Under Review
2018-19	Atlantic	Area 009 – Labrador Coast
	Central and Arctic	Area 110 – Kingston to Cornwall
		Area 010 - Eastern Arctic
		Area 155 - Hudson Bay - James Bay
		Area 259 – All lands and waters of the Northwest Territories
		Area 260 All lands and water areas of Nunavut except the water areas of Hudson and James Bays. Note: Islands in Hudson Bay & James Bay are lands of Nunavut.
	Western	306 – North Coast of BC
2019-20	To be determined based on Regional priorities	
2020-21	To be determined based on Regional priorities	
2021-22	To be determined based on Regional priorities	
2022-23	To be determined based on Regional priorities	

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Risk Based Analysis of Maritime SAR Delivery

Volume I – Strategic Overview

Safety First, Service Always



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Canada

Risk Based Analysis of Maritime SAR Delivery

CCG/GCC

Published under the Authority of:

Operations Directorate
Fisheries and Oceans Canada
Canadian Coast Guard
Ottawa, Ontario K1A 0E6

2nd Edition, August 2018

EKME # 2696593

Disponible en français :
[Analyse axée sur les risques de la prestation des services de SAR maritimes]

Printed on recycled paper

Record of Amendments

#	Date	Description	Initials
1	2014 April	1st Amendment	
2	2017-10-22	Document Amended to align with PDF version	MGN
3	2017-11-22	Amended to update to 2nd edition, November 2017 and updated page numbering	MGN
4	2018-03-30	Amended to add appendix 1 to Annex C replacing Table 24 Annex C.7. Completed Annex E including mapping of tables and matrices.	MGN
5	2018-09-14	RAMSARD Methodology Manual 2nd Edition amended to separate into Volumes I, II and III	MGN

Executive Summary

The Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) program provides the framework for an enhanced, robust and reinvigorated program to ensure that Canada remains a world-class leader in maritime SAR delivery, preparedness and response.

The objective of RAMSARD is to systematically manage risk decision-making pertaining to the CCG SAR delivery system, addressing issues raised by the Office of the Auditor General in the 2013 report on Search and Rescue, Chapter 7. The RAMSARD framework:

- Provides an integrated approach helping CCG reduce maritime SAR risks more effectively, and allocate SAR resources more systematically, with greater consistency;
- Facilitates the agency's decision-making related to maritime SAR risk management;
- Enables CCG to identify and respond effectively to perceptions of risk on the part of stakeholders, the public and other government agencies; and
- Supports accountability and transparency of decision making.

Under the RAMSARD framework, the areas within the three Search and Rescue Regions (SRR) are assessed continuously over a five-year cycle using resources and methodologies outlined in the RAMSARD Manual.

The RAMSARD Methodology Manual Volume 1 outlines the six-step process that is aligned with the CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines *(supersedes (CSA) standard Q850-97)*. RAMSARD Methodology Manual Volumes 2 and 3 offer an in-depth description and guide for the implementation of the RAMSARD methodology.

Key Deliverables:

- Annual review of maritime SAR areas to cover all areas in 5 years;
- Identification/monitoring of new maritime hazards and risks for national maritime SAR program delivery; and
- RAMSARD Area Reports, measuring risk according to the RAMSARD Methodology, and recommending risk mitigation, leading to effective maritime SAR program delivery.

Key Enablers:

- Cyclical adaptation of the RAMSARD Methodology manual;
- Coordination, consultation and cooperation with stakeholders and partners throughout the quinquennial cycle;
- Coordination of engagement requirements to leverage existing initiatives within the CCG, DFO, TC and other departments as appropriate.

Table of Contents

1 Introduction

1.1 Purpose

The purpose of the Risk Based Analysis of Maritime Search and Rescue Delivery (RAMSARD) Methodology Manual (Volumes I, II and III) is to support examination of maritime Search and Rescue (SAR) response delivery by the Coast Guard (CCG) and includes the contributions of supporting SAR partners.

1.2 Scope

The three volumes of the RAMSARD manual outline a scientifically supported methodology that requires collecting information to define the SAR risk environment in the SAR areas studied in each year. It is neither designed nor intended to examine or assess other aspects of SAR, such as prevention programs, regulation or enforcement services delivered by organizations and agencies external to CCG, nor is it intended to examine communications and coordination of maritime SAR response**.

***Nevertheless, these aspects can impact the adequacy and effectiveness of risk mitigation measures provided through CCG SAR response. In such a case, during the application of analysis processes described in the manual, these impacts will be noted and recommendations for their mitigation will be included. Such mitigation may require senior management engagement with other federal departments and agencies or non-federal organizations to seek their cooperation.*

The RAMSARD Methodology Manual Volume 1 outlines the six-step process that is aligned with the CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines (*which supersedes (CSA) standard Q850-97).* RAMSARD Methodology Manual Volume 2 provides an in-depth description and guide for the implementation of the RAMSARD methodology and Volume 3 offers a toolbox of resources, documents and checklists to be used by RAMSARD analysts.

1.3 Objective

The RAMSARD Methodology Manual – Volumes I through III provide the framework for the execution of the RAMSARD methodology regarding the allocation of resources in support of maritime SAR. The objective is to systematically manage risk decision-making pertaining to the CCG SAR delivery system and address issues raised by the Office of the Auditor General (*in the 2013 report on Search and Rescue, Chapter 7*) by:

- Providing an integrated approach to help CCG reduce maritime SAR risks more effectively, and allocate SAR resources more systematically, with greater consistency;
- Facilitating the agency's decision-making related to maritime SAR risk management;

- Enabling CCG to identify and respond effectively to perceptions of risk on the part of stakeholders, the public and other government agencies; and
- Supporting accountability and transparency of decision making.

1.4 History

In 1948, Canada signed the Convention for the Safety of Life at Sea, wherein, under Chapter 5, Regulation 15, each contracting state is required to undertake and ensure necessary arrangements for coast watching and for the rescue of persons in distress at sea. In 1958, Canada became a signatory to the Convention on the High Seas, wherein, under Article 12 (2), every coastal state is required to maintain an adequate and effective SAR service regarding safety on and over the sea. These responsibilities are further reflected and amplified in subsequent Cabinet decisions, and legislation such as the Canada Shipping Act, 2001 and the Oceans Act. The International Convention on Maritime Search and Rescue, 1979, further defines these responsibilities.

In support of Canada's Oceans Protection Plan (OPP) announced on November 7, 2016, by Prime Minister Trudeau, the risk-based analysis of maritime search and rescue delivery (RAMSARD) methodology was implemented nationally. Its intent was and is to address Pillar I of the Oceans Protection Plan in creating a state of the art marine safety system.

1.5 Maritime SAR Responsibility

The Government of Canada has accepted overall responsibility for maritime SAR response within Canadian Federal waters under international agreements. It has assigned the Canadian Coast Guard the role of coordinating maritime SAR response on its behalf and providing dedicated, on-water response capabilities, while mandating that all federal vessels and aircraft are available for SAR response tasking as appropriate to their capabilities.

Mitigation responsibility rests with other federal departments and agencies or non-federal organizations, while the CCG remains responsible to seek their cooperation in the application of related risk mitigation measures.

1.6 Federal SAR Framework

Given the requirement for particularly close coordination and seamless interoperability between the Coast Guard and the Canadian Armed Forces in fulfilling the maritime and aeronautical SAR mandates in Canada under the IAMSAR Manual and as described in the 2013 Spring OAG Report Chapter 7.27 & 7.100, the Federal SAR Operations Governance Committee was convened in March 2013. The committee serves as a bilateral framework between the Coast Guard and the Canadian Armed Forces to identify, monitor and address common issues and challenges. This committee is co-chaired by the Coast Guard's Deputy Commissioner of Operations and the Canadian Joint Operations Command (CJOC) Deputy Commander Continental, meeting twice

yearly to address issues such as resources, governance and ***risk management*** within the framework of the CCG and CAF federal SAR responsibilities.

1.7 Reference Documents

Relevant policies, guidelines and publications

Risk Management Policy – Treasury Board of Canada, April 1994

Integrated Risk Management Framework – Treasury Board of Canada, April 2001

Policy on Active Monitoring – Treasury Board of Canada, June 2001

CAN/CSA-ISO 31000-10 Risk Management — Principles and guidelines

CSA/Q850, Risk Management: Guideline for Decision-Makers CSA International, October 1997 (under review)

CCG National Strategies Risk Management Guidelines (RMG) 2009

2 Governance

2.1 Authority

The RAMSARD Methodology Manual is published under the authority of Director General Operations. It will be formally reviewed each year at the annual meeting of the RAMSARD analysts, considering best practices identified during the previous cycle, and to align with international risk assessment standards.

2.2 Management Responsibility

The Coast Guard implemented its risk-based analysis of maritime search and rescue delivery (RAMSARD) methodology nationally as part of its responsibility to address Pillar I of the Oceans Protection Plan and to replace the 2007 SAR Needs Analysis process. As RAMSARD evolves into a CCG program it will assist the Coast Guard in proactively identifying SAR areas with new or emerging maritime risks and ultimately ensures a more systematic approach to evaluating maritime SAR delivery in Canada. The review process is intended to be the SAR program planning tool resulting in improved SAR planning, decision-making and ultimately maritime safety. This process will support the Coast Guard responsibility in understanding maritime risks better, implementing mitigation measures within CCG control and recommend measures to other agencies responsible for carriage requirements and prevention activities.

2.3 Accountability

2.3.1 Strategic Oversight

The adoption of a more systematic approach to risk management decision-making addresses issues raised by the Office of the Auditor General in the 2013 report on Search and Rescue, Chapter 7. In Accordance With (IAW) the Canadian Coast Guard Maritime Services Risk Management Guidelines (April 2009), the RAMSARD Oversight Working Group (ROWG) will coordinate RAMSARD (project) activities and provide recommendations on issues or risks.

2.3.2 Project Execution

The routine execution of the RAMSARD project is over-seen by the Project Manager (Ops Requirements Analyst - RAMSARD, Ottawa) who is accountable to the Project Leader (Manager Search and Rescue, Ottawa). The Project Manager is responsible for the annual RAMSARD review cycle by providing guidance and support to the Regions for a standardized implementation. Currently the RAMSARD working group meets on a bi-weekly frequency. The participants include the two Regional analysts from each Region and the Project Manager (*See RAMSARD Project organization at* **figure** 1). Attendance by Manager SAR and (Regional) Superintendents are optional.

2.3.3 Project Reporting

Progress reporting is done thought the Project Management Office during the time where RAMSARD is under the plan. Progress reporting is done monthly through the OPP Steering Committee, chaired by the 3 DGs accountable for the OPP Projects. Regions report to Project Manager on bi-weekly basis. Project Manager reports monthly to Steering Committee

Commented [D1]: through

Commented [D2]: There is a bit of confusion in the acronyms between Regional Superintendent Maritime SAR vs Regional supervisor Maritime SAR. Suggest we rename the position to Deputy superintendent for SAR coordination for RSMS (JRCC) as suggested by Clay Evans

Commented [D3]: Would love to see a added box where SAR program officer GT-5 and RSMS of JRCC or MRSC are on the same line, and both reporting up to the Superintendent. I think we have to consolidate JRCC and MRSC as musts for consultation. I would prefer them on the same line as I would like 2 opinions as SAR superintendent.

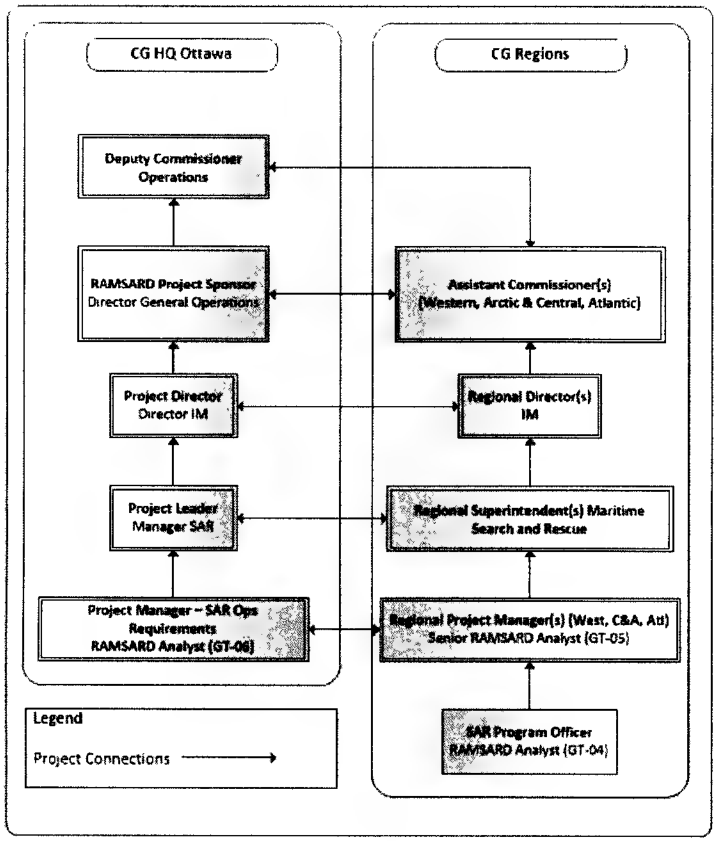

Figure 1 - RAMSARD Project Hierarchy

2.3.4 Program Delivery

The RAMSARD Program will evolve from the experience and lessons learned during the RAMSARD project phase for permanent implementation. The RAMSARD organization hierarchy, seen in **figure 2 – RAMSARD Organizational Relationships** below, depicts the related authorities

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involved in the SAR risk assessment and the implementation of the RAMSARD methodology. The process allows for the ongoing review of the effectiveness of maritime SAR delivery, encompassing primary, secondary and other SAR resources (CCG, DND, CCGA, local resources, and vessels of opportunity).

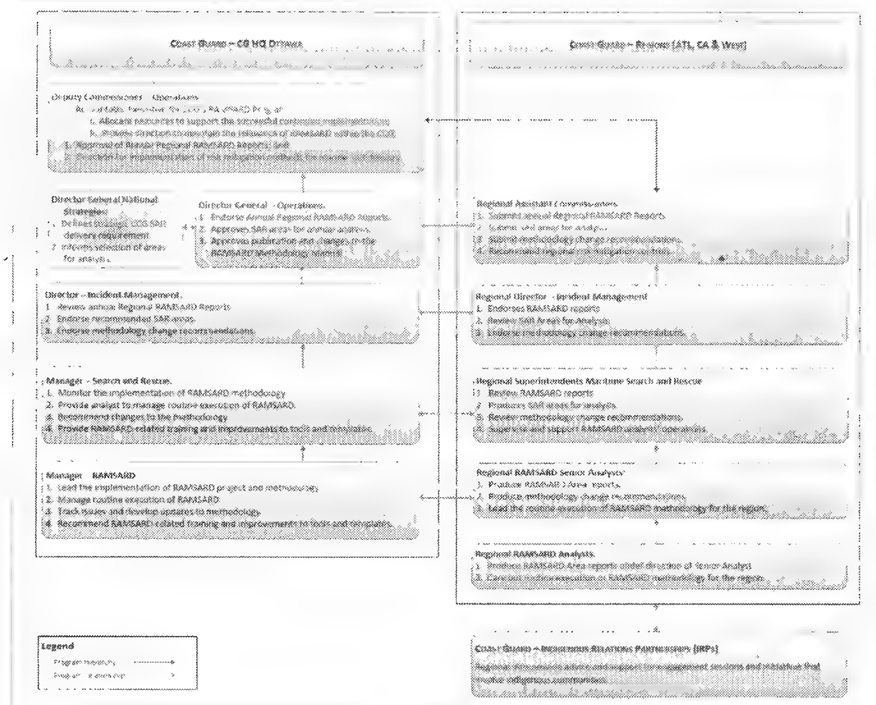

Figure 2 - RAMSARD Organizational Relationships

Commented [D4]: Same as above Integrate JRCC and MRSC officially in the process.

3 Planning

3.1 Five Year Assessment

Under the RAMSARD project framework, all the SAR Areas within the three Canadian Coast Guard Regions including Atlantic, Central and Arctic, and Western, will be systematically assessed over a five-year cycle using resources and methodologies outlined in the RAMSARD Methodology manual – Volume II. The application of a detailed and methodical RAMSARD analysis process will provide a more formal and comprehensive review of area risks and the effectiveness of SAR response in mitigating them.

Each of the SAR Areas within each Region must be reviewed once – as a minimum - on a five-year cycle. This will require multiple area reviews in any given year (i.e. two adjacent areas assessed simultaneously). The Annual selection of SAR areas for a RAMSARD review will be based primarily on Regional priorities. Regional Superintendents SAR will be responsible to recommend which SAR areas will undergo the RAMSARD review. The Regional Assistant Commissioners will submit areas and Director General of Operations will be responsible to approve the SAR areas identified for analysis.

The Manager – Search and Rescue is responsible to the Director General Operations through the Director Incident Management for changes to the Methodology Manual (in consultation with the Regions), the execution of RAMSARD and delivery of related training and improvements to the tools and templates.

3.2 Annual Planning Cycle

The Annual Planning cycle's structure is divided into six sections corresponding to the six Phases of the RAMSARD methodology. It is further defined and described in Chapters 3 and 4 (Pg. 11 – 49) of the RAMSARD Manual Volume II – Implementation. Supporting documentation and templates can be found in Volume III – Toolbox.

The annual planning activities often overlap from one Phase to another. Some are undertaken at various times throughout the entire RAMSARD cycle (e.g. Stakeholder, Partners and Clients Analyses Updates). Analysts may refer to the RAMSARD annual planning cycle chart at **figure 3** (Pg. 8) to see how the Phases relate to one another. Analysts may also want to create a similar "Time Line" showing the actions required, for planning purposes. Analyst may use the Engagement Plan example discussed in RAMSARD Volume II – 7.1.8 Engagement Planning (Pg. 23) to assist in the process.

The supporting documentation and templates included in Volume III are intended to be used by Analysts to plan and record risk management activities. Analysts should be aware that the six phases are repeated each year. **Figure 3** below provides a depiction of the annual cycle.

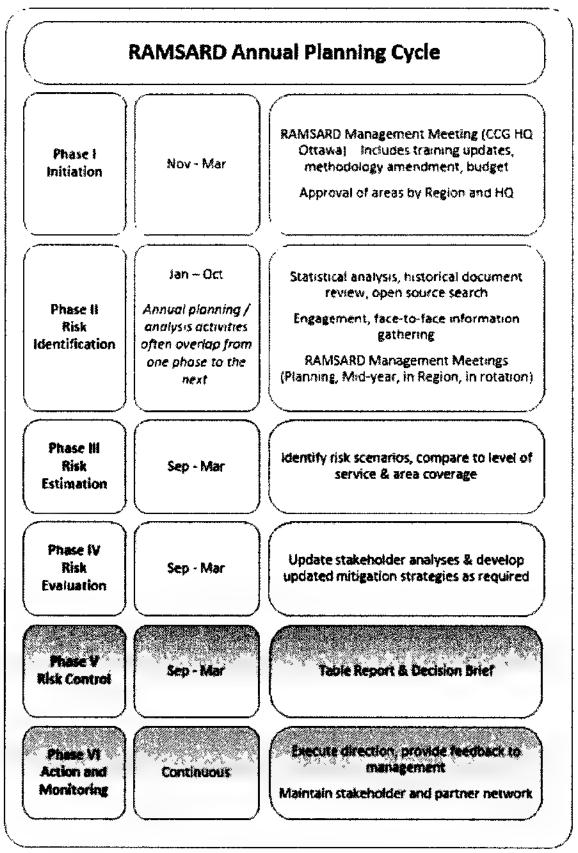

Figure 3 - Annual Planning Cycle

3.3 Documentation

The Manager Search and Rescue is accountable for the documentation of RAMSARD activities. A comprehensive description of the RAMSARD documentation process is found in RAMSARD Volume II – Implementation.

Further RAMSARD documentation template examples are presented in Volume III – Toolbox and individual templates may be found on the RAMSARD National Shared Drive at: RAMSARD (\\svmonkenclu01\NATSHARE01\NatSharedData) (Z:).

4 Resource Management

4.1 Provision of Resources

RAMSARD is initially funded through the Oceans Protection Plan for the first 5 years to support Pillar #1. Afterward, RAMSARD will become part of the SAR Program.

Financial Bundles Summary from TB Sub V1

Bundle	Initiatives	VOTE	Item	2017-18	2018-19	2019-20	2020-21	2021-22	5 Year total	On-going
5.3 National implementation of the Risk-based Analysis of Maritime Search and Rescue Delivery methodology	National implementation of the Risk-based Analysis of Maritime Search and Rescue Delivery methodology (RAMSARD) 8F100	OPERATING	Salaries	310,308	620,617	620,617	620,617	620,617	2,792,776	620,617
			O&M	266,452	432,505	368,740	368,740	368,740	1,805,178	398,945
			EBP	62,062	124,123	124,123	124,123	124,123	558,555	124,123
			Accommodations	40,340	80,680	80,680	80,680	80,680	363,061	80,680
			SSC Premium	2,450	4,900	4,900	4,900	4,900	22,050	4,900
5.3 National implementation of the RAMSARD				**681,612**	**1,262,825**	**1,199,061**	**1,199,061**	**1,199,061**	**5,541,620**	**1,229,265**

Figure 4 - Financial Summary for National Implementation of RAMSARD

4.2 Information Management

To make informed judgements in support of the public good, government decision-makers need more than the technical risk data obtained through traditional sources. The choice of data collection will reflect timing, resources, availability of data, the need for accuracy or the possible need for some statistical portrayal of the data, and the acceptance of the methodology by key stakeholders. This in turn will require:

- Strong innovative data from multiple sources (information assurance: e.g. access to SMMS, SISAR, INNAV, and Transportation Safety Board records);
- Good information management practices (storage, sharing, archiving); and
- Cyber security.

4.3 Human Resources

- CCG HQ provides one Project Manager RAMSARD (1 X GT-06)
- Regions provide 2 analysts per Region
    - **Atlantic:** (1 X GT-04 + 1 X GT-05)
    - **Central & Arctic:** (1 X GT-04 + 1 X GT-05)
    - **Western:** (1 X GT-04 + 1 X GT-05)

4.4 Training and Certification

4.4.1 Training

Training of RAMSARD Analysts shall be delivered on an annual basis by the Manager – Search and Rescue under the authority of the Director General Operations. Organization and funding will be managed through the Manager SAR and coordinated by the CCG HQ RAMSARD Analyst. The training model should account for and include annual succession planning.

4.4.2 Certification

On successful completion of RAMSARD training regional analysts shall be qualified and certified as a RAMSARD Specialist in accordance with Coast Guard policies. Analysis, design, development and implementation of the RAMSARD Specialist training and certification will be confirmed at a later date.

5 RAMSARD Methodology Overview

5.1 Key Concepts

Systematic risk management is about applying a systematic approach to decision-making; its benefits result more in improved decision-making in general than in improved risk management specifically. With strengthened ability to make informed decisions, there is strengthened ability to make informed judgements about risk issues as well.

The risk management decision process is designed to provide decision-makers with sufficient information such that informed judgements can be made about the trade-offs associated to the decision situation under consideration, such as alternative resource configurations for SAR activities. The decision process is the same for all decisions, regardless of whether decisions are about the pursuit of opportunities or the avoidance of risk-related losses.

5.2 Principles

Throughout the analysis of CCG SAR response delivery using the three volumes of this Manual, several overlying principles should be taken into consideration, particularly with respect to consultation and dialogue with stakeholders:

- There are limitations to what is reasonably achievable, in terms of SAR response alone: "The times and locations of distress situations are not predictable, and no amount of resources can guarantee that all people will be saved."[1] Indeed, response to SAR incidents once they occur represents, in reality, the final opportunity for mitigation of the risk to life posed by hazards existing in the maritime environment or resulting from the behavior and decision-making of individuals.
- "Individuals are primarily responsible for their safety and for not endangering others."[2] An individual planning and preparing to operate on the water possesses the broadest range of opportunities and abilities to influence the outcome of maritime activities. Even once engaged in activities on the water, the individual retains the greatest span of control

[1] Government of Canada, Office of the Auditor General, *1992 Report of the Auditor General of Canada*, Chapter 8 – Search and Rescue, para 8.2, Internet: http://publications.gc.ca/collections/collection_2015/bvg-oag/FA1-1-1992-eng.pdf; Accessed: 31 August 2018

[2] Government of Canada, Office of the Auditor General, *1992 Report of the Auditor General of Canada*, Chapter 8 – Search and Rescue, para 8.11, Internet: http://publications.gc.ca/collections/collection_2015/bvg-oag/FA1-1-1992-eng.pd; Accessed: 31 August 2018

over the outcome through prudent behavior and decision-making to avoid becoming involved in a SAR incident (prevention) or by ensuring the ability to summon help in a timely fashion and survive long enough to assist rescuers in locating the incident and for the provision of life-saving assistance (preparedness). Stakeholders must recognize and acknowledge their individual responsibility for their own safety and the fact that they alone possess the greatest ability to assure positive outcomes to their maritime activities.

- Response to maritime SAR incidents in Canada's waters under federal jurisdiction is not the sole purview of CCG; for incidents at the distress level (M1) or those with the potential to become distress incidents without intervention (M2), the operative principle will be to aid in reducing or mitigating the risk to life as quickly as possible, regardless of the source of such assistance or specific capabilities. In the maritime environment, proximity to the incident location rather than a formal mandate to respond will most often dictate the source of such initial assistance. Indeed, under international maritime law and as enacted through the Canada Shipping Act all vessels, regardless of nationality or role, may be ordered by a Search and Rescue Mission Coordinator (SMC) within the CAF/CCG Joint Rescue Coordination Centres to render assistance to a vessel in distress, to the extent that doing so would not place the tasked vessel and those aboard in jeopardy themselves.[3]

Commented [D5]: add "or Marine Rescue Subcentre (MRSC)" after JRCC

- Adding or enhancing response capabilities should not be considered the primary means of mitigating risks in the maritime environment. The number of uncontrolled and uncontrollable variables renders response among the least effective of risk mitigation means, not to mention that response also often imposes risk on the responders. Risk avoidance by individuals, through planning, preparation and prudent behavior and decision-making is by far the most effective and ultimately the least costly means of protecting lives and property during activities in the maritime environment.

Although not within the purview of CCG, nor the primary focus of analyses undertaken using the processes in this manual, measures to educate, encourage and, where appropriate, regulate and enforce sound planning, preparation, behavior and decision-making among those potentially at risk in Canada's maritime environment will nevertheless often be identified and recognized as means to reduce risk during such analyses. These measures should be taken into account and included when considering the recommendation of actions to mitigate risks.

[3] Government of Canada, Canada Shipping Act, 2001 (S.C. 2001, c. 26) Search and Rescue – Power of Rescue Coordinators 130(2). Internet: http://laws-lois.justice.gc.ca/eng/acts/C-10.15/page-16.html#docCont Accessed: 13 September 2018

5.3 Methodology

5.3.1 Six Step Process

The RAMSARD Manual outlines a six-step process aligned with the CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines (*supersedes (CSA) standard Q850-97*). The focus and objectives of the six steps are shown in **figure 5** below. Continuous communication is critical through the process (see Paragraph 3.3 above).

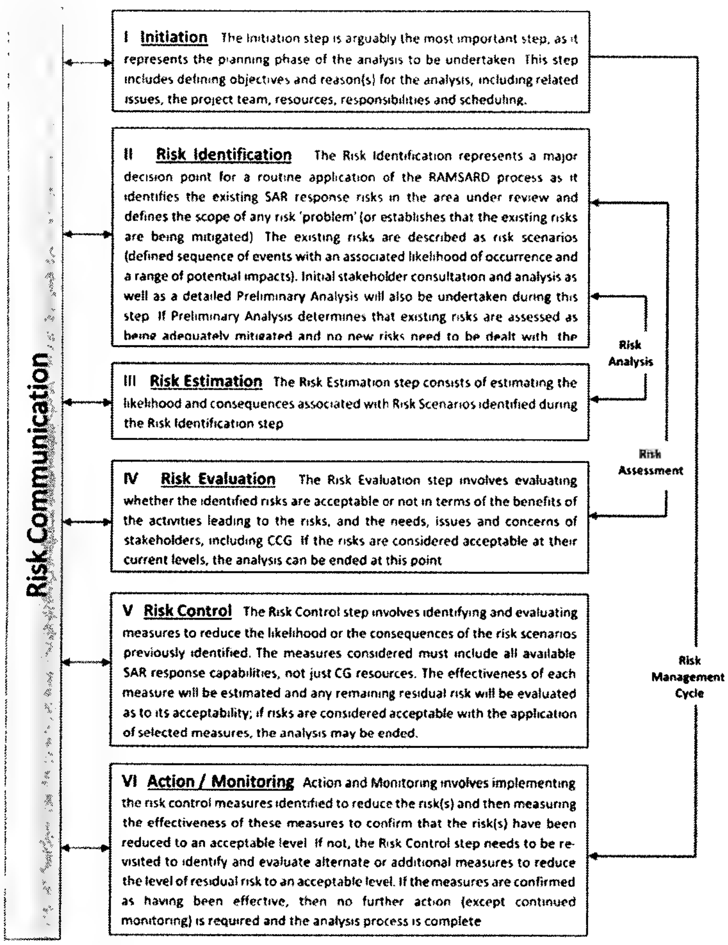

Figure 5 - Six Step Process

Commented [D6]: Risk ID paragraph is cut off and unreadable

Commented [D7]: Section VI : measure repeated to often. We are not measuring the measure taken, we are assessing or evaluating their effectivemess Figure 5 section VI "the risk control measures identified to reduce the risk(s) and then measuring the effectiveness of the measures" recommend changing measuring to another word such as evaluating or assessing

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5.3.2 Risk Communications

Effective Networking is at the heart of the successful delivery of RAMSARD. Therefore clear, consistent communication is required among:

- Internal Stakeholders: Personnel and organisations internal to CCG in National Strategies, Operations, and Regions
- External stakeholders: Personnel from Federal SAR organisations, which includes DND/CAF, RCMP, Transport Canada, CBSA, and PSC
- Partners: organisations that have authority in the Maritime safety domain, such as provincial/territorial (EMO), international (UN/IMO), municipal (police, fire,) and Indigenous communities
- Clients (users of the maritime areas, or affecting marine activities): sectors or communities such as academia, industry/commercial, recreational, volunteer, and not-for-profit

Research has shown that decisions arising out of a systematic decision process are more acceptable to stakeholders than those arising out of more intuitive approaches. They carry more credibility. Employing a systemic process that has credibility builds trust with stakeholders, partners and clients but also provides proof that the necessary diligence has been shown in addressing issues. A credible process provides a good defense in support of government decisions and the CAN/CSA-ISO 31000-10 enjoys international credibility.

5.3.3 Application

The aeronautical and maritime SAR system differs from many risk analysis and decision-making situations for which the CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines (*supersedes (CSA) standard Q850-97*) was intended, in that, an ongoing but informal state of consultation with stakeholders, partners and clients and monitoring of system effectiveness exists. As a result, there will likely be no great revelations during an application of the RAMSARD process; however, in terms of detail and methodical analysis, the routine, 5-year application of RAMSARD will provide a more formal and comprehensive review of SAR Area risks and the effectiveness of SAR response in mitigating them.

5.3.4 Outcomes and Key Performance Indicators

This initiative falls under the State-of-the-Art Marine Safety System pillar and supports the achievement of the following thematic and shared initiative outcomes:

- **Thematic Outcome**: Canada's marine safety system is better positioned to prevent and respond to marine safety events; and
- **Shared Outcome**: Enhanced risk-based planning and decision-making.

The Key Performance Indicators (KPI) for the RAMSARD are:

- number of Search and Rescue regions reviewed using the RAMSARD methodology each year; and
- confidence in the reports generated through the RAMSARD process.

6 Conclusion

6.1 An Integrated Approach to Risk Management

The RAMSARD Methodology Manual (Volumes I, II and III) is consistent with the principles and processes contained within the CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines (*supersedes (CSA) standard Q850-97*). This publication is recognized internationally and has been adopted departmentally as the basis for risk management practices. The three volumes of the RAMSARD Methodology Manual are designed to:

- Provide a structured process for identifying, analyzing, evaluating and documenting risks in a consistent manner across the federal SAR system;
- Provide a process for evaluating current maritime SAR response capability and capacity in terms of efficiency and effectiveness in mitigating risks within the Federal maritime environment under the jurisdiction of the CCG; and
- Provide a process for identifying and evaluating alternative resource configurations.

As such, the RAMSARD manual supports an integrated approach to risk management and decision-making.

6.2 Guidelines - Use of Volumes One, Two and Three

RAMSARD Methodology Manual Volume 1 - Strategic Overview

Provides a concise description of the systematic decision-making process adopted by the CCG to providing direction on risk management activities through an agreed upon vision, a common set of principles, a common risk management methodology and integration of risk management considerations with existing practices.

RAMSARD Methodology Manual Volume 2 – Implementation

Will provide clearly defined guidelines for the application of the RAMSARD methodology. It defines a logical step-by-step explanation of the methodology and the means of application throughout the process. It is intended to support RAMSARD Analyst resources, documentation and checklists contained in the RAMSARD Methodology Manual Volume 3 – Toolbox.

RAMSARD Methodology Manual Volume 3 – Toolbox

Provides the resource information, forms and reports used as part of the methodology along with the supporting descriptions of how the forms and reports are to be completed.

Annex A – Glossary of Terms

Commented [D8]: MRSC, Aeronautical Incident, Humanitarian Incident and Federal SAR Operations Governance Committee to list of definitions

English	French	Definition
Aeronautical incident	**Incident aéronautique**	A search and rescue incident involving an aircraft
Benchmark	**Point de référence**	A measurable guideline of what can be expected (e.g. timeliness, accuracy, access).
CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines	**ISO 31000 - Formation De Sensibilisation - Gestion Des Risques**	Has superseded (CSA) standard Q850-97, Risk Management: Guidelines for Decision-Makers.
Capacity	**Capacité**	The availability and response time of vessels in an area capable of providing search and rescue response.
Capability	**Aptitude**	The ability of vessels, aircraft and crews to provide response to search and rescue cases, as evaluated by aircraft/vessel characteristics (size, speed, sea keeping, etc.), equipment carried, and crew training and qualifications.
Civil Air Search and Rescue Association (CASARA)	**Association civile de recherche et sauvetage aériens (ACRSA)**	A volunteer organization which provides aeronautical search and rescue support.
Canadian Coast Guard Auxiliary (CCGA)	**Garde côtière auxiliaire canadienne (GCAC)**	A volunteer organization which assists the Canadian Coast Guard in search and rescue response and prevention activities.
Consultation	**Consultation**	The seeking and giving of advice, information, and/or opinion, usually involving a consideration.

English	French	Definition
CSA Q850	**Norme CSA Q850**	Risk Management: Guideline for Decision-Makers. The Canadian Standard Association's risk management standard. This national standard of Canada provides an effective, credible, and internationally recognized framework for decision-making about the broadest range of risk decisions.
Decision-Maker	**Décideur**	A person or group with the power or authority to make decisions.
Dialogue	**Dialogue**	A process for two-way communication that fosters understanding. It is supported by exchange of information.
Distress	**Détresse**	A search and rescue incident where there is a reasonable certainty that one or more individuals are threatened by grave and imminent danger and require immediate assistance.
Fast Rescue Craft (FRC)	**Embarcation rapide de sauvetage (ERS)**	A rigid-hull inflatable with a V-shaped, fiberglass hull and inflatable sponson around the perimeter.
Hazard	**Danger**	A source of potential harm, or a situation with a potential for causing harm, in terms of human injury, damage to health, property, the environment, and other things of value, or some combination of these.
Humanitarian Incident	**Incidents d'ordre humanitaire**	A search and rescue incident (not aeronautical or maritime) which requires a response by the search and rescue system to preserve human life or relieve suffering.

English	French	Definition
Inter-departmental Committee on Search and Rescue (ICSAR)	**Comité interministériel de recherche et sauvetage (CIRS)**	Consists of senior officials representing federal departments and agencies involved in the National Search and Rescue program. The committee is responsible for advising the Lead Minister of Search and Rescue and the government on issues related to search and rescue in Canada. ICSAR exists to provide interdepartmental co-ordination and advice to the Ministers in the Areas of search and rescue policy, planning, resources, and effectiveness.
Incident rate	**Taux d'incidents**	The number of incidents relative to the amount of traffic.
Initiation	**Lancement**	Consists of defining and structuring the organization's objectives; defining the opportunity or problem triggering the need for risk management decisions; identifying associated risk issues; setting up the risk management team; and beginning the identification of affected stakeholders.
International Maritime Organization (IMO)	**Organisation maritime internationale (IMO)**	The United Nations' specialized agency responsible for safety and security of shipping and for the prevention of marine pollution by ships.
Inshore Rescue Boat (IRB)	**Embarcation de sauvetage côtier (ESC)**	A seasonal Canadian Coast Guard program in which university students (in some regions with Canadian Coast Guard coxswains) operate a fast rescue craft and provide response to search and rescue incidents during the high season.
Joint Rescue Coordination Centre (JRCC)	**Centre conjoint de coordination des opérations de sauvetage (JRCC)**	One of three centres in Canada (in Halifax, Trenton, and Victoria), jointly staffed by Canadian Forces and Canadian Coast Guard personnel responsible for planning, co-ordinating, controlling and conducting aeronautical and maritime search and rescue operations within their Search and Rescue Region.

English	French	Definition
Level of Service (LOS)	**Niveau de service (NS)**	Standards designed to provide Canadian Coast Guard clients with a clear understanding of the services to be expected.
Lives at Risk	**Vies en danger**	The sum-total of lives saved, and lives lost in distress and potential distress incidents.
Lives Lost	**Vies perdues**	Lives lost during a search and rescue incident (maritime, aeronautical or humanitarian).
Lives Saved	**Vies sauvées**	Persons whose lives were at risk during a search and rescue incident, but who survived.
Loss	**Perte**	An injury or damage to health, property, the environment, or something else of value.
Maritime Incident	**Incident maritime**	A search and rescue incident on the water involving a vessel or a person, including the medical evacuation of person(s) from a vessel.
Mass Rescue Operation (MRO)	**Opération de sauvetage en masse**	Characterised by the need for immediate response to large numbers of persons in distress such that the capabilities normally available to the SAR authorities are inadequate.
Matrix	**Matrice**	A tool where options are evaluated against set criteria to aid in the decision-making process.
Medical Evacuation (Medevac) - critical	**Évacuation médicale (Medevac) – critique**	The critical evacuation of injured or stranded persons from isolated Areas or the recovery of sick or critically injured persons from vessels at sea.
Medical Evacuation (Medevac) - routine	**Évacuation médicale (Medevac) – routine**	The routine medical evacuation of patients or vital medical resources from one medical facility to another (aeronautical or maritime ambulance service).

Commented [D9]: The definition below should say **or a person from a vessel** like in CAMSAR or it could be used to say swimmers, divers, people committing suicide are marine incidents also

Commented [D10]: FROM CAMSARD :
Medical evacuation (MEDEVAC) - Evacuation of a person for medical reasons.
Medical evacuation – Critical - The transfer of persons under medical care where the situation is deemed to be life threatening in terms of either the patient's serious condition or isolated location.
"évacuation médicale critique"
Medical evacuation – Rescue - The critical evacuation of injured or stranded persons from isolated areas, or the recovery of sick or critically injured persons from vessels at sea.
"évacuation médicale de sauvetage"
Medical evacuation – Routine - The transfer of a patient from one medical facility to another where delay would not unduly compromise the patient's condition

English	French	Definition
Monitoring	**Surveillance**	As part of the risk management decision process, the undertaking of a conscientious review of an operating environment or system and of its associated decision processes. The monitoring program has four key purposes: to detect and adapt to changing circumstances; to ensure that the activities are achieving the results expected of them; to ensure proper implementation of communication, control and residual risk strategies; to verify correctness of assumptions.
National SAR Secretariat (NSS)	**Secrétariat national de recherche et de sauvetage (SNRS)**	An autonomous arm's length organization within the Department of National Defense, accountable to the Lead Minister for Search and Rescue (Minister of National Defense). Established in 1986, the NSS is responsible for the management and coordination of the National Search and Rescue Program.
On-Scene Coordinator	**Coordonnateur sur les lieux**	The commander of a search and rescue unit designated to co-ordinate search and rescue operations within a specified search area.
Primary SAR Resources	**Ressources primaires de SAR**	Federal search and rescue aircraft and vessels, including those multi-tasked to SAR, established and equipped specifically for search and rescue, with search and rescue trained crews aboard. Primary search and rescue resources are under the direct operational control of the Search and Rescue Region Commander for search and rescue tasking and maintain a maximum 30-minute state of readiness.
Problem	**Problème**	An undesirable event or situation that has occurred or will certainly occur in the future. A **problem** is something you must deal with now, whereas a **risk** is something you should plan for in the future.

Commented [D11]: This definition is not correct. Primary Marine resources hold a 30 min standby period but Primary Air resources hold either a 30 min or a 2hr standby depending on the day or time of day. Correct wording is that Primary SAR assets maintain a standby for SAR activities

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English	French	Definition
Rescue Coordination	**Coordination des opérations de sauvetage**	The function of integrating the efforts of search and rescue facilities and resources to achieve concerted and harmonized resolution of search and rescue incidents in an effective and efficient manner.
Residual Risk	**Risque résiduel**	The risk remaining after all risk control strategies have been applied.
Risk	**Risques**	An expression of exposure to loss. 1. The potential of injury or loss, as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value. 2. The uncertainty that surrounds future events and outcomes. It is the expression of the likelihood and impact of an event with the potential to influence the achievement of an organization's objectives.
Risk Analysis	**Analyse des risques**	The systematic use of information to identify hazards and estimate the chance for, and severity of, injury or loss to individuals or populations, property, the environment or other things of value.
Risk Assessment	**Évaluation des risques**	The overall process of Risk Analysis and Risk Evaluation. It involves identifying risks and assessing the effects of those risks on program delivery and program effectiveness.
Risk Communications	**Communications des risques**	A set of communication and consultation activities designed to support the decision process by providing information necessary for defining stakeholder issues and for understanding the trade-offs inherent in the decision situation. **Any two-way communication between stakeholders about the existence, nature, form, severity or acceptability of risks.**

English	French	Definition
Risk Control Option	**Option de maîtrise des risques**	An action intended to reduce the frequency and/or severity of injury or loss, including a decision not to pursue an activity. Risk control options should be evaluated in terms of their cost, their effectiveness in reducing losses and their impact on other stakeholder objectives.
Risk Control Strategy	**Stratégie de maîtrise des risques**	A program which may include the application of several risk control options.
Risk Estimation	**Estimation des risques**	The activity of estimating the likelihood of a risk scenario occurring and estimating the impact on defined objectives if it does occur. The activity of estimating the frequency or probability and consequence of risk scenarios, including a consideration of the uncertainty of the estimates.
Risk Evaluation	**Évaluation des risques**	The process by which risks are examined in terms of cost and benefits, and evaluated in terms of their acceptability, considering the needs, issues, and concerns of stakeholders.
Risk Identification	**Détermination des risques**	The identification of situations that can negatively impact the achievement of the organization's objectives, described as risk scenarios.
Risk Management	**Gestion des risques**	The systematic application of management policies, procedures and practices to the tasks of analyzing, evaluating, controlling, and communicating about risk issues.
Risk Perception	**Perception des risques**	The significance assigned to risks by stakeholders. This perception is derived from the stakeholders' expressed needs, issues, and concerns.
Risk Scenario	**Scénario de risque**	A defined sequence of events with an associated likelihood and range of impact.

English	French	Definition
Search and Rescue (SAR)	**Recherche et sauvetage (SAR)**	Search and rescue comprises the search for, and provision of aid to, persons, ships or other craft which are, or are feared to be, in distress or imminent danger.
Search and Rescue Area	**Secteur de recherche et sauvetage**	Sub-divisions of the three Search and Rescue Regions, search and rescue Areas are statistical Areas created by the Department of National Defence for data collection purposes.
Search and Rescue case	**Cas de recherche et sauvetage**	Any situation where the search and rescue system respond or would have responded had it been alerted at the time the situation was happening.
Search and Rescue Incident	**Incident de recherche et de sauvetage**	Any reported situation which has the potential to require a response from the search and rescue (SAR) system. A SAR incident becomes a SAR case when the SAR system responds or would have responded had it been alerted at the time of the incident.
Search and Rescue Mission Coordinator (SMC)	**Coordonnateur de mission de recherche et sauvetage (CMRS)**	The official temporarily assigned to co-ordinate response to an actual or apparent distress situation.
Search and Rescue Region (SRR)	**Région de recherche et sauvetage (RRS)**	An area of defined dimensions associated with a Joint Rescue Coordination Centre within which search and rescue services are provided.
Search and Rescue Region Commander	**Commandant d'une région de recherche et sauvetage (CRRS)**	The person designated by the Chief of Defence Staff and authorized by the Canada Shipping Act, 2001 as being responsible for search and rescue operations within a Search and Rescue Region.
Search and Rescue Resource	**Ressource de recherche sauvetage**	A resource capable of responding to a search and rescue incident.

English	French	Definition
Search and Rescue stakeholders	**Recherche et sauvetage parties prenantes**	Belong to one of two distinct groups: partners, who work with CCG to support and/or deliver SAR services; and clients, who are the potential recipients of SAR response services.
Stakeholder	**Partie prenante**	Any individual, group, or organization able to affect, be affected by, or that believes it might be affected by, a decision or activity. The decision-maker(s) is a stakeholder.

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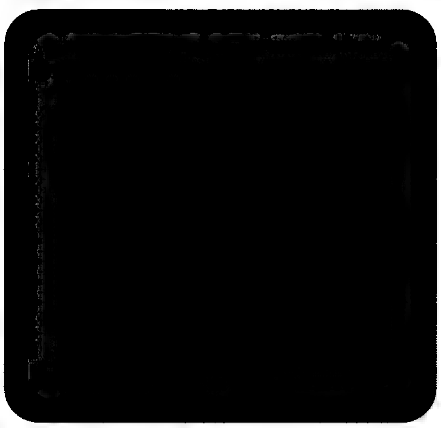
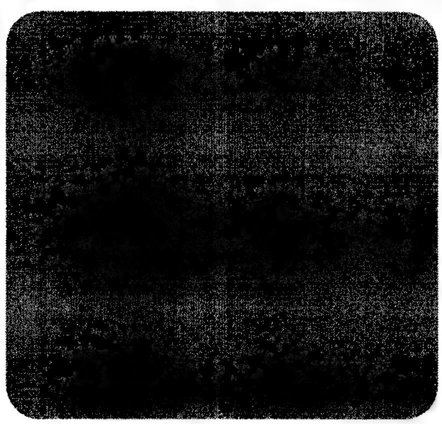
Risk Based Analysis of Maritime SAR Delivery

Volume II - Implementation

Safety First, Service Always






EKME #2696593

Canada

Risk Based Analysis of Maritime SAR Delivery

CCG/GCC

Published under the Authority of:

Operations Directorate
Fisheries and Oceans Canada
Canadian Coast Guard
Ottawa, Ontario K1A 0E6

2nd Edition, August 2018

EKME # 2696593

Disponible en français :
[Analyse axée sur les risques de la prestation des services de SAR maritimes]

Printed on recycled paper

Record of Amendments

#	Date	Description	Initials
1	2014 April	1st Amendment	
2	2017-10-22	Document Amended to align with PDF version	MGN
3	2017-11-22	Amended to update to 2nd edition, November 2017 and updated page numbering	MGN
4	2017-03-30	Amended to add appendix 1 to Annex C replacing Table 24 Annex C.7. Completed Annex E including mapping of tables and matrices.	MGN
5	2018-12-03	RAMSARD Methodology Manual 2nd Edition amended to separate into Volumes I, II and III	MGN

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1 INTRODUCTION – IMPLEMENTATION METHODOLOGY

INTENT

The Risk-based Analysis of Maritime Search and Rescue Delivery (RAMSARD) program provides the framework for an enhanced, robust and reinvigorated program to ensure that Canada remains a world-class leader in maritime SAR delivery, preparedness and response.

Under the RAMSARD project/program framework, the SAR Areas within the three Canadian Coast Guard Regions including Atlantic, Central and Arctic, and Western, will be systematically assessed over a five-year cycle using resources and methodologies outlined in the RAMSARD Methodology manual – Volume II. The application of a detailed and methodical RAMSARD analysis process will provide a more formal and comprehensive review of area risks and the effectiveness of SAR response in mitigating them.

BACKGROUND

The purpose of RAMSARD is to systematically manage risk decision-making pertaining to the CCG SAR delivery system, addressing issues raised by the Office of the Auditor General in the 2013 report on Search and Rescue, Chapter 7. The RAMSARD framework:

- Provides an integrated approach helping CCG reduce maritime SAR risks more effectively, and allocate SAR resources more systematically, with greater consistency;
- Facilitates the agency's decision-making related to maritime SAR risk management;
- Enables CCG to identify and respond effectively to perceptions of risk on the part of stakeholders, the public and other government agencies; and
- Supports accountability and transparency of decision making.

SCOPE

The three volumes of the RAMSARD methodology manual outline a scientifically supported methodology that requires collecting information to define the SAR risk environment in the SAR areas studied in each year.

OBJECTIVE RAMSARD – VOLUME II

The objective of the RAMSARD Methodology Manual - Volume II is to provide comprehensive guidance to RAMSARD analysts in the performance of their duties. Volume II presents an in-depth description and guide for the implementation of the RAMSARD methodology.

AN INTEGRATED APPROACH TO RISK MANAGEMENT

The RAMSARD Methodology Manual – Volume II is consistent with the principles and processes contained within the CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines (*which has superseded (CSA) standard Q850-97*). This publication is recognized internationally and has been adopted departmentally as the basis for risk management practices. The RAMSARD methodology is designed to:

- Provide a structured process for identifying, analyzing, evaluating and documenting risks in a consistent manner across the SAR system;
- Provide a process for evaluating current maritime SAR response capability and capacity in terms of efficiency and effectiveness in mitigating risks in the maritime environment; and
- Provide a process for identifying and evaluating alternative resource configurations.

As such, the RAMSARD manual supports an integrated approach to risk management and decision-making.

AUTHORITY

The RAMSARD Methodology Manual – Volume I through III is published under the authority of Director General Operations.

RESPONSIBILITY

The Manager – Search and Rescue is responsible to the Director General Operations through the Director Incident Management for changes to the RAMSARD Concept of Operations and Methodology Manual, the execution of RAMSARD and delivery of related training and improvements to the tools and templates.

ACCOUNTABILITY

The routine execution of the RAMSARD project is over-seen by the Project Manager who is accountable to the Project Leader. The Project Manager is responsible for the annual RAMSARD review cycle by providing guidance and support to the Regions and ensuring standardization. The accountability structure will be updated as the RAMSARD project evolves to program status (See figure 2 RAMSARD Volume I Pg. 6).

DESCRIPTION

The CCG risk management methodology involves the application of logical and systematic methods to:

- establish the context for identifying, analysing, evaluating, treating risk associated with the Search and Rescue (SAR) environment;
- communicate and consult throughout the process;
- monitor and review identified risks; and
- report and record the results appropriately.

Risk assessment is that part of risk management which provides a structured process that identifies how objectives may be affected and analyses the risk in term of consequences and their probabilities before deciding on whether further treatment is required.

2 A PRIMER ON RISK MANAGEMENT AND DECISION-MAKING

Before describing the processes of risk management and decision-making that form the basis of the RAMSARD Methodology Manual, an introduction to the basics of risk management and how it supports decision-making will assist in understanding the approach.

INTRODUCTION TO RISK MANAGEMENT

Increasingly, government and private sector organizations are embracing a more systematic approach to risk management. This new interest results partially from an increased call for accountability at all working levels, but it also reflects a need to work more effectively with fewer available resources to carry out the required workload. "Doing less with less" is becoming more the norm in these economic times. A more systematic approach to decision-making will help CCG make better decisions about how it does its business.

Risk management, however, is not something new; we all use some form of risk management decision-making in our day-to-day lives, be it intuitive or structured. For example; each day we seek to minimize the risks posed by the weather we get up and we define our objectives (e.g. do we care if we get wet, do we wish to avoid overexposure to sunlight and the attendant cancer risk; we then read the paper or listen to the radio (risk communication) for the current forecast to identify impending weather and its associated risks. Based on this information, we make judgements about the likelihood and consequences of adverse weather events and then, based on our objectives, we make decisions. We evaluate whether the risk is acceptable to us. If we do decide to go outside, we make decisions to control the risks (e.g. what to wear or what mode of transportation to use). All of this amounts to a form of systematic risk management decision-making. However, our risk management efforts are not always perfect, as we have all been caught out in the rain without an umbrella.

If risk management is not new, and if we, as individuals, do it all the time, why is there a sudden interest on the part of government departments and agencies? The answer lies in the fact that while we are all capable of good risk management, we do not always do it in a consistent manner; and while we are often good risk managers, we are often poor decision-makers. More than thirty years of behavioral decision research shows consistently, that in experiments and in real life situations, "humans are quite bad at making complex, unaided decisions"[1] A more structured approach to risk management decision-making helps in overcoming the problems with decision-making from which we all suffer. The use of a systematic process helps ensure more comprehensive analysis, and it also provides for continuous improvement over time. We get better at applying a systematic process the more we use it, something that does not occur with intuitive approaches.

More importantly, perhaps, is that decisions resulting from structured decision processes carry greater credibility than those arising from unstructured (including intuitive) processes. Decisions based on unstructured processes are often seen as arbitrary rather than analytical.

[1] P. Slovic, B. Fischhoff, and S. Lichtenstein (1977). "Behavioural Decision Theory." Annual Review of Psychology, 28, 1–39.

The basic goal in applying a risk management decision framework is to provide decision-makers with sufficient information about existing risks and about the trade-offs inherent in choosing options for dealing with these risks. When we evaluate alternatives, not only do we look at their effectiveness in reducing risks and their costs, but we also need to consider their impact on other defined objectives of the organization and of stakeholders. A systematic approach aids in these efforts.

The approach to risk management we have adopted within CCG provides an effective, credible, and internationally recognized framework for decision-making about the broadest range of risk decisions. It is a step-by-step approach that will help us do better at what we do.

FUNDAMENTALS OF DECISION-MAKING

Systematic risk management is fundamentally about applying a systematic approach to decision-making; its benefits result more in improved decision-making in general than in improved risk management in particular. When we strengthen our ability to make informed decisions, we strengthen our ability to make informed judgements about risk issues as well.

There are two fundamentals associated with all decisions, including risk management decisions:

- Decision-making revolves entirely around objectives. We decide to do things in pursuit of objectives and we decide to avoid things that might inhibit the attainment of objectives. Essentially, objectives form our decision criteria; and
- All decisions, including a decision to do nothing, involve trade-offs. For example, we can inspect facilities more often and perhaps improve safety, but this requires more resources; we can save money by inspecting less, but this may impact on safety.

The risk management decision process is designed to provide decision-makers with sufficient information such that informed judgements can be made about the trade-offs associated to the decision situation under consideration, such as alternative resource configurations for SAR activities. The decision process is the same for all decisions, regardless of whether decisions are about the pursuit of opportunities or the avoidance of risk-related losses.

There are two key benefits associated with using a systematic approach to decision-making:

- A structured, step-by-step approach helps overcome the problems that all humans share when it comes to making decisions. It helps us avoid jumping to conclusions before sufficient analyses have been completed. It forces us to identify a broader range of options and it provides a framework for evaluating these options so that we do not favour a particular solution while overlooking other, potentially better, choices; and
- A structured decision process increases the organization's credibility with other stakeholders, by increasing the acceptability of decisions arising from the decision process. This leads to increased cooperation between government and stakeholders, and an increased likelihood of developing policies and programs that gain widespread public and industry support.

Given the principle that a structured decision process helps provide for more informed judgements, it follows that a structured communication/consultation process and solid

documentation are essential components of the decision framework. Informed judgements cannot be made without sufficient, relevant information upon which to base these judgements.

The risk communication process provides the framework for acquiring the information necessary for making informed judgements. It also provides means for sharing this information between decision-makers and stakeholders.

A comprehensive well-structured documentation system ensures that the collection process is easily managed, and the required information is easily accessible.

COMMUNICATIONS CONSULTATIONS AND DECISION-MAKING

The 2007 SAR Needs Analysis identified a lack of timely consultation with stakeholders, partners and clients. It is also recognized that the foundation of the RAMSARD six step process, including the Environmental Scan is based on a through understanding of and adherence to stakeholder communications principles.

The intent of this section is to provide guidance for consultation and risk communications, including those consultations expected through each stage of the Risk-Based Analysis methodology. A more detailed discussion is contained within the CCG National Strategies Risk Management Guidelines (RMG).

Risk Communications are defined as a set of communication and consultation activities designed to support the decision process by providing information necessary for defining stakeholder issues and for understanding the trade-offs inherent in the decision-situation.

The concept of Risk Perception is important in that different stakeholders will view each risk through their own frame of reference. Consultations will provide decision-makers with a better understanding of the values, objectives and emotional qualities that form the basis of the stakeholders' perception of risk.

Through consultations, stakeholders will perceive that the decision process is systematic, with a broader range of options and a framework for evaluating those options. A structured decision process and effective communications should result in the improved credibility of decision-makers with other stakeholders and a greater likelihood of reaching a broader consensus.

2.1.1 Principles

Where possible, communications will be conducted through existing mechanisms, both at Headquarters and within regions;

- A Stakeholder Analysis (RMG 2009, 2.9.1 Pg. 18) shall be conducted early in the process to identify stakeholders, level of interest, issues and other relevant information;
- Consultations shall be structured not just to inform stakeholders of intended actions, but to gather from stakeholder insight, perspective and information otherwise not available to decision-makers; and
- Not every decision requires extensive analyses or consultations. More complex decisions with higher risks, or with a higher level of concern on the part of stakeholders, require broader and deeper consultations, with attendant documentation.

2.1.2 National Communications / Consultation

Internal to CCG, through discussion between SAR team members, other National Strategies and Operations teams, with methodology approved by and decision-making done by Operations Executive Board (OEB) and CCG's Management Board;

- Sharing of methodology and opportunity for input appropriate by National Search and Rescue Committee, National Search and Rescue Secretariat (NSS) and National Marine Advisory Board (NMAB);
- Consultation with SAR partners in CAF (national liaison) and CCGA; and
- Communication via CCG website and other media.

2.1.3 Regional Communications / Consultation

Internal to CCG, through discussion between SAR team members, other National Strategies and Operations teams;

- Sharing of methodology and opportunity for input to process at various stages of process (beginning, during and at conclusion) with Regional Marine Advisory Board, Local Marine Advisory Council, Canadian Marine Advisory Council, Recreational Boating Advisory Council and other stakeholder groups;
- Dialogue with potentially affected communities (e.g. when considering the addition, removal or change of resources); and
- Consultation with SAR partners in CAF (through the JRCC) and CCGA.

DOCUMENTATION

There may be a need for extensive documentation throughout the risk management process; or documentation requirements may be modest if the issues under discussion are relatively inconsequential and if public interest is relatively low.

Documentation:

- aids in explaining decisions;
- is necessary for defending decisions after they have been made;
- provides a reference for future risk management processes so as to facilitate
- continuous improvement;
- supports the monitoring function;
- provides the basis for all decisions, in that all decisions are based on
- information;
- provides a record of proceedings; and
- aids in communicating reasons for decisions to other stakeholders.

It may be critical that documentation be detailed and comprehensive, as in cases where litigation is a possibility. However, the need for documentation should reflect the importance (to stakeholders) of the risk decisions to be taken, the level of concern regarding these issues,

and/or the resources available to the decision-maker. Reasonable efforts should be made to document the process without generating excessive or unnecessary paperwork.

Documentation may provide the organization with an important resource for future decisions, just as a lack of documentation may generate serious problems for the organization. As such, the amount of documentation to be provided should be a matter of serious consideration on the part of the decision-maker. While decision-makers are cautioned against being secretive, some information may need to remain confidential.

Here are some considerations when deciding on the level of detail in the documentation.

- A more detailed documentation is usually required if there are legal considerations associated with the decision situation.
- If there is substantial media or public interest in the situation; more analysis and more detailed documentation may be required to respond to this interest.
- If the consequences of the decisions are significant; more analysis and more detailed documentation may be necessary.
- If the analyses are complex; more detailed documentation may be necessary.
- If there are political ramifications; more analysis and more detail in the documentation may be prudent.

2.1.4 Documentation Guidance

The Six-Step process provides guidance with respect to what needs to be documented throughout the RAMSARD process. While the use of documentation may vary, analysts should be conscious of potential legal implications, where decisions may need to be defended in a court of law. Although the documentation descriptions discussed in the process are very comprehensive, the majority of decision situations will not necessarily generate a significant level of documentation.

For most analyses, enough documentation needs to be provided so that, for example, an outside manager can understand:

- What the problems and associated risk issues are;
- Who the stakeholders are and what form of consultations, if any, were undertaken with them;
- The results of these consultations;
- What, and why, decisions were made, throughout the process; and
- How and why the options for dealing with the identified issues were chosen.

Essentially, the documentation should describe the case for the decision(s) in as few words as practical.

3 METHODOLOGY PREFACE

This preface to the in-depth description to the RAMSARD methodology is a repetition of the information in contained in Volume I but bears repetition, as it defines fundamental principles associated to SAR in general and SAR in the federal maritime environment. These principles should be taken into consideration, especially when engaged in consultation and dialogue with stakeholders, partners and clients of the maritime SAR system.

PRINCIPLES

Throughout the analysis of CCG SAR response delivery using this Manual, several overlying principles should be taken into consideration, particularly with respect to consultation and dialogue with stakeholders:

- There are limitations to what is reasonably achievable, in terms of SAR response alone: "The times and locations of distress situations are not predictable, and no amount of resources can guarantee that all people will be saved." Response to SAR incidents represents the final opportunity for mitigation of the risk to life posed by hazards existing in the maritime environment or from the behavior and decision-making of individuals.
- "Individuals are primarily responsible for their safety and for not endangering others." An individual planning and preparing to operate on the water possesses the broadest range of opportunities and abilities to influence the outcome of maritime activities. Stakeholders must recognize and acknowledge their individual responsibility for their own safety and the fact that they alone possess the greatest ability to assure positive outcomes to their maritime activities.
- Response to maritime SAR incidents in Canada's waters under federal jurisdiction is not the sole purview of CCG; for incidents at the distress level (M1) or those with the potential to become distress incidents without intervention (M2), the operative principle will be to provide assistance in order to reduce or mitigate the risk to life as quickly as possible, regardless of the source of such assistance or specific capabilities. In the maritime environment, proximity to the incident location rather than a formal mandate to respond will most often dictate the source of such initial assistance.
- Adding or enhancing response capabilities should not be considered the primary means of mitigating risks in the maritime environment. The number of uncontrolled and uncontrollable variables renders response among the least effective of risk mitigation means, not to mention that response also often imposes risk on the responders. Risk avoidance by individuals, through planning, preparation and prudent behavior and decision-making is by far the most effective and ultimately the least costly means of protecting lives and property during activities in the maritime environment.

Although not within the purview of CCG, nor the primary focus of analyses undertaken using the processes in this manual, measures to educate, encourage and, where appropriate, regulate and enforce sound planning, preparation, behavior and decision-making among those potentially at risk in Canada's maritime environment will nevertheless often be identified and recognized as

means to reduce risk during such analyses. These measures should be contemplated and included when considering the recommendation of actions to mitigate risks.

RAMSARD RISK MANAGEMENT MODEL

The Volume II outlines a six-step process that is built on the Risk Management Model defined in CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines (*which has superseded (CSA) standard Q850-97).* A synopsis of the tasks within the six steps are outlined in figure 1 below and the tasks involved in each step are further developed in Section Six.

Two further elements of the process that may not be readily apparent include **Risk Communications** and **Environmental Scanning**. Each of these elements are imbedded within the process itself and are critical to the overall success.

Risk communications with internal and external stakeholders, partners and clients provide a link to throughout the process to successful decision-making and support from those stakeholders, partners and clients *(see Section 3 above for a more detailed discussion*).

Another significant aspect of the six-step process that is not immediately apparent is **environmental scanning**. The information provided through the environmental scan helps to build a comprehensive picture of each of the SAR areas under review and can be compared with previous scans to identify gaps in a changing environment. Its value cannot be understated.

Risk analysis is the systematic use of information to identify hazards and to estimate the chance for and severity of, injury or loss to individuals or populations, property, the environment, or other things of value.

Risk assessment is the overall process of risk analysis and risk evaluation.

Risk management cycle defines the systematic and cyclical application of management policies, procedures, and practices to the tasks of analyzing, evaluating, controlling, and communicating about risk issues.

The six steps include: Initiation, Risk Identification, Risk Estimation, Risk Evaluation, Risk Control, and Action and Monitoring. The focus and objectives of each step are demonstrated in the diagram that immediately follows.

3.1.1 Annual Planning Cycle - Expanded

The work undertaken within the planning cycle for RAMSARD is often overlapping from one phase to another. Some components are undertaken at various times throughout the entire RAMSARD cycle (e.g. Stakeholder Analyses Updates). Analysts may refer to the RAMSARD annual planning cycle chart at figure 3 (Volume I Pg. 8) to see how the Phases relate to one another. Analysts may also want to create a similar "Time Line" showing the actions required, for planning purposes.

Figure 1 – Risk Management Model

Risk Communication

I Initiation The Initiation step is arguably the most important step, as it represents the planning phase of the analysis to be undertaken. This step includes defining objectives and reason(s) for the analysis, including related issues, the project team, resources, responsibilities and scheduling.

II Risk Identification The Risk Identification represents a major decision point for a routine application of the RAMSARD process as it identifies the existing SAR response risks in the area under review and defines the scope of any risk 'problem' (or establishes that the existing risks are being mitigated). The existing risks are described as risk scenarios (defined sequence of events with an associated likelihood of occurrence and a range of potential impacts). Initial stakeholder consultation and analysis as well as a detailed Preliminary Analysis will also be undertaken during this step. If Preliminary Analysis determines that existing risks are assessed as being adequately mitigated and no new risks need to be dealt with, the analysis can be ended at this point.

Risk Analysis

III Risk Estimation The Risk Estimation step consists of estimating the likelihood and consequences associated with Risk Scenarios identified during the Risk Identification step.

Risk Assessment

IV Risk Evaluation The Risk Evaluation step involves evaluating whether the identified risks are acceptable or not in terms of the benefits of the activities leading to the risks, and the needs, issues and concerns of stakeholders, including CCG. If the risks are considered acceptable at their current levels, the analysis can be ended at this point.

V Risk Control The Risk Control step involves identifying and evaluating measures to reduce the likelihood or the consequences of the risk scenarios previously identified. The measures considered must include all available SAR response capabilities, not just CG resources. The effectiveness of each measure will be estimated and any remaining residual risk will be evaluated as to its acceptability; if risks are considered acceptable with the application of selected measures, the analysis may be ended.

Risk Management Cycle

VI Action / Monitoring Action and Monitoring involves implementing the risk control measures identified to reduce the risk(s) and then measuring the effectiveness of these measures to confirm that the risk(s) have been reduced to an acceptable level. If not, the Risk Control step needs to be re-visited to identify and evaluate alternate or additional measures to reduce the level of residual risk to an acceptable level. If the measures are confirmed as having been effective, then no further action (except continued monitoring) is required and the analysis process is complete.

4 SIX-STEP PROCESS

STEP ONE - INITIATION

4.1.1 General

This step consists of defining and structuring the organization's objectives; defining the opportunity or problem triggering the risk management decisions; identifying associated risk issues; setting up the risk management team; and beginning the identification of affected stakeholders.

4.1.2 Initiation Responsibility

Launch of each year's activities towards the five-year routine application of RAMSARD Analysis will be done via a Director General, Operations' letter to Assistant Commissioners in the Regions. This letter will direct the Assistant Commissioners to identify an appropriate number of SAR Areas to be reviewed (in order to complete all areas as referenced within the 5-year cycle) and will schedule a three-day meeting at CCG Headquarters to discuss and plan the activities. It may also specify certain SAR Areas to be reviewed in that year's Analysis.(Normally recommended input will be provided from the regions as a "bottom-up" approach)

Commented [GN1]: Need to define where to confirm "bottom up" approach.
Note reference added to confirm 5-year plan..

In considering the SAR Areas to propose for review, Regions should consider the impact of shared CCG response resources between adjacent SAR Areas and the logic in reviewing those SAR Areas concurrently. Regions also may be aware of emerging situations or issues in respect to SAR response in certain SAR Areas which might prioritize their review ahead of others. This information, along with a general sense of the Areas being proposed for review, will be topics for discussion at the Initiation meeting in Ottawa.

4.1.3 Initiation Objectives.

The most important first step when making any decision is to define the fundamental objectives in the context of the decision situation. In other words, define what matters with regards to the program and to the decisions to be made at the end of the process. This may be in the context of the program's objectives and/or it may also address larger strategic CCG objectives. These fundamental objectives provide the criteria for the decisions that will be taken during and at the completion of the Analysis.

In the case of a routine, 5-year cyclic application of the RAMSARD process, the objective is quite simple: Confirm that SAR response delivery in the area under study is adequate (i.e. meeting the CCG Performance Standard in terms of lives saved versus lives at risk), that CCG resources are being used effectively and efficiently, and that there are no known or emerging risks that require further analysis and consideration of resource adjustment. CCG Management may direct a RAMSARD application to a SAR Area or Areas for other reasons, such as in response to political concerns regarding SAR response or consideration of resource allocation changes. In these cases, the objective(s) of the analysis will be specified in the initiating direction from senior management.

4.1.4 Initiation Planning

The Initiation step is an important element in the decision process. It is the planning Step, and the necessary time should be taken to get it right. In this step of the process the following needs to be accomplished:

1. Define the fundamental objectives of the Analysis;
2. Define any specific issues pertaining to the Analysis or the area(s) under review;
3. Identify the Analysis Team(s);
4. Assign responsibilities and confirm resources for the Analysis;
5. Identify stakeholders to be consulted (by activity/organization/category); and
6. Develop a plan and schedule for the analysis, including stakeholder consultations.

The basic initiation elements are further described below.

4.1.4.1 Define the problem or opportunity (Objective).

The next consideration is to define precisely the issue or opportunity leading to the Analysis. What is the trigger for the decision(s) that will be taken? Defining the problem sets the scope for analysis and helps keep it focused. Note however that as the analysis proceeds, there may be a need to redefine the scope as new information becomes available.

4.1.4.2 Identify the associated issues.

For planning purposes, it is also important to identify the full range of concurrent issues likely held by stakeholders (the program included), as this will also affect the scope of the Analysis. What are the impacts of the issue or opportunity, and of the decisions being considered? How important are they to stakeholders?

4.1.4.3 Analysis Team

It will be important to identify who will be involved throughout the analysis, and at what point in the analysis they are required to be available. For instance, internal and external stakeholders will be involved in consultation(s), and CCG management positions will be involved in review of progress. Once it is identified who is needed and when they are needed, task assignment can begin, and a timeline can be developed for the Analysis.

4.1.4.4 Decision-Makers

What decisions need to be made, when they need to be made and who will be making them, must also be identified at this stage. Sometimes the decisions will be made by the Analysis Team; sometimes, the decisions will be made by others. Decision-makers may require prior notice before they provide a decision, and this may need to be scheduled ahead of time (e.g. CCG Management Board).

***Note:** Although the Analysis Team will comprise SAR experienced personnel, there will also most likely be a need to involve others at some stage. For example, contributors might be needed to provide information for the Analyses, to provide legal advice or other expert opinions, to make decisions, or to supply other resources. The better these external contributors can be identified and provided advanced notice of the requirements and dates, the more likely they will be available with the input required so as not to delay the completion of the analysis.*

4.1.4.5 Stakeholders

Finally, it must be determined who the stakeholders for this decision situation might be. Who will be affected by the decisions being made and who might have an impact on what these decisions are? These stakeholders will need to be consulted and communicated with throughout the process, and a plan should be developed to carry out these consultations. Fundamentally, communications through consultations support the Risk Analysis/Risk Management decision process, and as such this aspect needs to be coordinated.

4.1.4.6 Communication and Consultation Objectives

In this regard, the first step is to identify the communication and consultation objectives. During a RAMSARD Analysis of SAR response in an area, two-way communication will be essential and should be planned to occur throughout the process to support decision-making. Information should be provided to stakeholders and information, concurrence or at least confirmation of understanding should be elicited from stakeholders.

4.1.5 Decision Process

The purpose of the decision process is to provide decision-makers with sufficient information so that they can make informed judgments about the trade-offs inherent in choosing amongst alternative courses of action. The communication process provides the means for the flow of information between decision-makers and other stakeholders.

The key decisions that need to be made at this Initiation step relate to the following questions:

- Have the fundamental objectives relevant to the decisions to be made been identified?
- Have any problems or opportunities been accurately and completely identified?
- Has the range of issues with which the Analysis will have to deal been identified?
- Have all of the stakeholders to be consulted been identified (at least by organization)?
- Has the (core) Analysis Team been identified and resources for the Analysis confirmed?
- Has a schedule and plan for the Analysis, including consultations, been developed?

The following pages contain a Guide for Initiation Actions to be undertaken, a basic list of data and information to be gathered to support the Analysis, and a simple checklist to record completion of each of these tasks.

4.1.6 Initiation Documentation Requirements

The documentation should define in detail the fundamental objectives of the organization including:

- Define the problem or opportunity that triggered an initiation of the risk management decision process;
- Define the risk scenarios associated with the problem or opportunity, and who these issues are associated with (e.g. CCG, public, other stakeholders);
- Provide details of any assumptions being made to identify the problem, opportunity or associated issues;
- Provide an initial list of stakeholders related to the specific decisions under consideration; and
- Describe the Analysis Team and their roles and responsibilities.

Note: There may only be a need to document this once as the fundamental objectives of the organization should not change much over time. However, should changes be made to priorities or objectives, the documentation should be updated to reflect these changes.

4.1.7 Initiation Actions

1. **Fundamental objectives of the Analysis:**
   - Routine (5-year) analysis confirms that:
     - SAR response delivery in the area under review is adequate (meeting CCG's 90% Performance Standard in terms of lives saved versus lives at risk);
     - CCG resources are being used effectively and efficiently;
     - *There are no known or emerging risks that require further analysis; or*
     - Special (Directed) analysis: The above, plus: specific direction from authorising authority.
2. **The problem or opportunity to be addressed:**
   - Routine (5-year) analysis: None; or
   - Special (Directed) analysis: specific direction from authorising authority.
3. **Specific issues pertaining to the Analysis:**
   - Issues may vary with each region and time period.
4. **Identify the Analysis Team (Positions indicated are notional only):**
   - Team Leader:
   - Analyst 1:
   - Analyst 2:
   - Analyst 3:
   - Analyst 4:
   - Consultant 1:
   - Consultant 2:

- Consultant 3:
- Legal Advisor:
- Financial Advisor:
- Communications Advisor:
- Others:

5. **Assign responsibilities (Examples):**
   - data gathering (takes time: assign everyone);
   - environmental scan preparation (use 2007 Needs Analysis as basis and update);
   - stakeholder consultation coordination (names and contact information to set consultations);
   - data presentation and graphics preparation (slides for consultation briefings, tables and graphs for report);
   - report writing and preparation; and
   - travel/meeting logistics.

4.1.8 Data Requirements

These are suggested reports/data to be gathered and analyzed. It is not necessarily a complete or limiting list, but teams should avoid collecting too much with data as it must be analyzed to provide useful information and shape conclusions. For very busy SAR Areas with many incidents, this data analysis will consume much staff time and effort and plans should be made accordingly.

Annually, CGHQ shall submit a national request for SISAR data on behalf of the three regions. The purpose is to ensure uniformity of reported data.

Table 1 - Data Sources

SOURCE	INFORMATION
Statistical information SAR (SISAR)	• Incident summaries for all incidents for 5 years. • Numbers/classification of incidents. • Location of incidents (lat/long). • Persons on board/lives lost/missing. • Response numbers to incidents by resource type. • Resource reaction time for each class of incident and resource type (CCG, RCAF, CCGA, etc.). • Resource time to arrive on-scene. • Incidents per search object activity (pleasure craft, fishing, marine transportation, etc.).
JRCC	SAR Operations Reports - for significant incidents.
Transportation Safety Board (TSB)	Accident Investigation Reports.
SAR Mission Management System (SMMS)	As incident data is assessed and analyzed it may be necessary to access specific case files from SMMS in order to extract more detailed information.
Information System on Marine Navigation (INNAV)	Commercial shipping movements statistics.
Environment Canada	Climatological information as applicable to the Area under review, including ice coverage.
Port Authorities	Cruise ship visit statistics (visits/passengers).
Ferry Operators	Ferry movement statistics (passengers carried).
NAV Canada	Commercial air transits/landings in area and average passenger loads.
Natural Resources Canada	Offshore oil exploration/wells information.

Note: Some of this data and information will be used to analyze the SAR response activity in the area, whereas other information will be used to provide context for the Analysis via the updated Environmental Scan.

4.1.9 Communications and Consultation - Initiation

Begins with identification of stakeholders and create stakeholder list (national, regional, area) with updated contact information - this will be documented throughout process cycle.

4.1.9.1 Engagement Planning

Engagement refers to both communications to / from and consultations with all parties affecting or affected by the RAMSARD process – i.e. stakeholders, partners and clients

The Engagement Plan is a framework document that Analysts can use to plan and record engagement activities. Further information is found in RAMSARD Volume III under Engagement Actions and an Engagement Template is available under Documentation Templates. The Engagement Plan includes and describes templates that might contribute to the implementation of engagement activities. Analysts can decide how to populate and whether to integrate these templates in this Engagement Plan.

This Plan's structure mirrors the six-step process of the RAMSARD Manual; it is divided into six sections corresponding to the six Steps of the RAMSARD methodology.

Engagement activities often overlap from one Step to another. Some are undertaken at various times throughout the entire RAMSARD cycle, e.g. Stakeholder Analyses Updates. Analysts can refer to the RAMSARD Time Line chart to see how the Steps relate to one another. Analysts may also want to create a similar "Time Line" showing the actions listed here, for planning purposes.

Table 2 - Initiation Checklist

Fundamental Objectives Defined?	YES - NO - N/A
Problems or Opportunities Identified?	YES - NO - N/A
Issues Pertaining to the Analysis?	YES - NO - N/A
Analysis Team Identified/Resources Confirmed?	YES - NO
Responsibilities Assigned?	YES - NO
Stakeholders Identified?	YES - NO
Plan and Schedule for Analysis Developed?	YES - NO

4.1.10 Initiation Process

Create Stakeholder List

- Initial identification of stakeholders.
- Update List throughout all RAMSARD phases.
- List to have National, Regional and Area components.

Make Initial Contact with Stakeholders

- Identify and contact key stakeholders.
- Foster understanding of methodology.

- Make initial Request for Input (RFI) if stakeholder has sufficient understanding of process (otherwise wait until you have further engaged and educated stakeholder).

4.1.11 Evaluation & Initiation -Template(s)

Information, forms and documents identified are based on Engagement Planning concepts. They will assist in the management of this step and can be found in RAMSARD - Volume III.

Stakeholder List

- List of Stakeholders [TBD]
- Step 1 Data & Information Sources
- Step 1 Initiation Checklist
- Step 1 Initiation Actions

Initial Contact with Stakeholders

- Request for Inputs: CCG; RCAF; CCGA; Partners; Clients

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

STEP TWO - RISK IDENTIFICATION

4.1.12 General

The focus of the **Risk Identification (Preliminary Analysis)** step is to define the scope of the decisions, identify exposures to loss (risks), and then describe these risks as risk scenarios.

The rationale of undertaking a preliminary analysis is to define the basic dimensions of the risk problem and to then undertake a back-of-the-envelope identification, analysis and evaluation of potential risks; usually with readily available data.

This preliminary evaluation will help determine:

1) Whether a situation exists that requires immediate action;
2) Whether the matter requires further study prior to any action being taken; or
3) Whether the analysis should be ended as the risk problem is determined not to be an issue.

The Key questions to be asked at the Risk Identification step are:

a. Have all the key risks been identified?
b. Have all the key stakeholders been identified?

4.1.13 Purpose

The purpose of the Risk Identification step is to:

- Define the scope of the decisions;
- Identify exposures to loss (risks);
- Describe these risks as risk scenarios - a defined sequence of events with an associated frequency (likelihood) and range of consequences (impact); and
- Conduct a Preliminary Analysis.

4.1.14 Risk Identification Planning

Preliminary Analysis - The purpose of undertaking a Preliminary Analysis is to define the basic dimensions of the risk problem and to undertake an identification, analysis and evaluation of potential risks. This is done using readily available information and data (e.g. SISAR incident data / SAR Operations Reports and TSB Reports), as well as confirmed and/or supplemented by information received during an initial stakeholder consultation.

This Preliminary Analysis will help determine:

- Whether a situation exists that requires immediate action;
- Whether the matter requires further study prior to any action being taken; or
- Whether the Analysis should be ended as the risk problem is determined not to be an issue.

Note: A Preliminary Analysis may be all that is necessary for decision-makers to make an informed judgement about the issue(s).

Scope of Analysis - The Analysis will be defined by the breadth of issues that are to be addressed and what to exclude. This will include program and CCG issues, but it may be prudent to limit the scope with respect to other stakeholder issues. For example, public or industry stakeholders may raise issues that are outside the mandate of the program, such as fisheries or vessel safety regulatory issues. In cases where a decision is taken to exclude consideration of some stakeholder issues, you will need to communicate reasons for doing so.

It is important to define the scope of the Analysis at the start so that efforts remain focused. However, the scope could be expanded later if the situation changes. The scope of analysis will comprise of:

- A description of the activity presenting the issue or opportunity (e.g. considering the re-locating or replacement of a SAR response resource serving the area under review);
- The possible risks associated with the activity (e.g. the re-located or replacement SAR response resource may not contribute to the same degree in meeting the Performance Standard);
- The decisions that will need to be made (e.g. should the proposed SAR response resource change be enacted?);
- The criteria for making any decisions (e.g. can other SAR response resources serving the area compensate for the relocated or replacement resource so that the Performance Standard is still met?);
- The decision-makers (e.g. CCG management);
- Stakeholders (e.g. client groups in the area, SAR response partners, etc.); and
- Any assumptions or constraints affecting the decisions (e.g. assumption that partners' SAR response resources will remain unchanged).

4.1.15 Communications and Consultations - Risk Identification

- Beginning with Stakeholder Analysis, consultation and information gathering - gauge level of interest and issues, seek insights, perspective and information otherwise not available.
- Consult as to accuracy of weather conditions to ensure key aspects are identified.
- Consult as to user profiles - accuracy of data, gain consensus regarding estimates (e.g. pleasure craft volume), and identify probable future trends.
- Share SAR incident data with SAR partners (e.g. CAF, CCGA) and clients - focus on information that is most relevant to these groups (e.g. response times for partners, incident trends if identified, how lives are lost) and verify whether data is consistent with expectation of SAR service.

4.1.16 Environmental Scanning

A critical and sometimes misunderstood aspect of the risk analysis process is environmental scanning. The Environmental Scan is normally completed as part of the Risk Identification step.

To provide clarity, a detailed description, explanation and breakdown of the steps of the environmental scan process is provided here.

Environmental scanning is defined - as the acquisition and use of information about events, trends and relationships in the external environment, the knowledge of which would assist management in planning a future course of action.

Changes to the CCG's environment can generate changes to the risks faced. Old risks may disappear, or new risks may arise. An environmental scan is used to identify changing circumstances within an area of responsibility; that is, the "environment" within which the organization operates.

In the business world, environmental scanning helps an agency develop the understanding of the internal and external environment needed to determine whether the business needs of the agency are in sync with the competency and availability of the resources (e.g. human, materials, money and other physical assets to effectively operate). Environmental scanning was originally a concept from the business management world by which businesses gathered information from the environment to give themselves a competitive advantage. Environmental scanning is now widely used by the public and private sector as part of any strategic or business planning process. Environmental scanning can help the CCG shape its resource management plans in response to rapid changes and create a vision of future requirements.

For the purposes of the RAMSARD Methodology Manual, an Environmental Scan is defined as 'an analysis of external factors significant to SAR program delivery.'

Within the RAMSARD process the environmental scan is used to identify changing circumstances within the SAR area under review; that is, the "environment" within that SAR Area. This could mean changes to the international agreements Canada has with other nations, changes to the CCG's policies or programs, emerging business opportunities in Canada, or changes to the way the CCG operates, among others. Changes to the environment can generate changes to the risks faced. Old risks may disappear, or new risks may arise.

The Environmental Scan will be prepared in order to describe the area in terms of its dimensions, its climatology (i.e. prevailing winds and speeds, average wave heights, temperatures, and the presence of sea ice and/or icebergs), its maritime geography (i.e. coastline, inlets, rocks, shoals, etc.), and its demographics related to the maritime environment (i.e. coastal population centres, deep water ports, maritime activity statistics, etc.). As a starting point, the information from the 2007 SAR Needs Analysis may be used and updated with more current climate information available from Environment Canada.

Maritime activity data from various sources as appropriate:

- Participating vessels and Long-Range Identification and Tracking (LRIT) data from CCG's Marine Communication and Traffic Services;
- Fishing seasons, zones, fishing effort data from DFO sources;
- Ferry data from ferry companies or Ferry Operators Association; and

- Whale watching, kayaking, deep sea fishing, etc. data from local associations or Departments of Tourism.

Note: Pleasure craft data has been elusive in the past. Methodologies have been developed, and data captured on both the East and West Coasts. These methodologies and data should be the starting point as they may be sufficiently current and representative for the purposes of the RAMSARD.

4.1.17 Environmental Scan Components

The environmental scan process is used to identify changing circumstances within the area of under review; that is, the current "environment" within which the CCG operates (*CCG Maritime Services Risk Management Guidelines, April 2009*). It follows a logical progression that identifies and describes potential emerging trends. A description of that process is shown below. Further guidance and a work template can be found in Volume III – Section XXXX

4.1.17.1 SAR Area Description

The environmental scan first includes an examination of the SAR Area itself:

- delineated boundaries by latitude and longitude (as created by the Department of National Defence for statistical purposes);
- geographical location and basic physiological features of the area;
- significant points of interest within (tall bridges, dangerous areas, areas of high activity, etc.); and
- finally, identification of which Rescue Coordination Centre is responsible for SAR coordination in this SAR Area.

4.1.17.2 Demographics

The demographic aspects of the area are examined, including

Society – qualities of the local population significant to SAR program delivery, such as;

- language,
- population variances by season (if any),
- cultural factors (subsistence fishing, etc.), or
- any other factors of note.

Examination of this aspect involves use of historical and current research sources and local knowledge of SAR personnel.

4.1.17.3 Technology

Technology – communications technology capability in the area as relevant to SAR, including:

- coverage (i.e. cell phone, VHF, DF),
- gaps in coverage,

- changes planned in the area (e.g. increase in coverage, removal of service), and
- the effectiveness of existing communications among SAR providers.
- This includes review of technology such as satellite communications, GMDSS, and any other technology used in the detection of incidents, such as AIS on the Great Lakes. Any technological services relating to the marine environment are considered relevant.

This assessment involves:

- research of existing services and service capabilities,
- employment of knowledge and experience of SAR and MCTS personnel working in the area, and
- examination of planned technological changes by service providers. Information from this section can be used, in part, to assess SAR Communications.

4.1.17.4 Economic / Maritime Activity

Economic – review of activity relative to area economy and significant to SAR or the maritime environment, including activity from:

- Commercial vessels, commercial-recreational vessels,
- ferries and passenger vessels,
- fishing, aquaculture, pleasure craft, government vessels,
- aircraft, and
- as related to the oil and gas industry.

The study of activity in these categories can be carried out by thorough review of data collected using existing vessel tracking systems, and departments such as Transport Canada, Department of Fisheries and Oceans, and other related federal departments for the period.

An examination of future trends for vessel activity by category may also carried out to better inform the analysis.

4.1.17.5 Climate Analysis

An examination of climate by season in each Area should be conducted using averages of 30+ years of collected data for climate parameters including:

- prevailing wind direction
- mean seasonal wind speed (in knots)
- mean seasonal maximum wind speed (in knots)
- percentage frequency of wave height greater than 2.0 metres
- mean air temperature (in degrees Celsius)
- mean seasonal minimum sea surface temperature (in degrees Celsius)

- percentage frequency of visibility less than 1 nautical mile
- percentage of fog occurrence
- mean seasonal maximum of current speed (in knots)
- mean seasonal sightings of icebergs
- mean days per season of ice coverage with concentration greater than 7/10ths and thickness greater than 15cm
- mean area ice coverage with concentration less than 7/10ths and thickness greater than 15cm
- old ice present
- first-year ice present.

These statistics may be provided through Environment Canada inclusive by SAR area. A table summarizing climate statistics should be included in the environmental scan.

For the purposes of the environmental scan the seasons are defined as:

- Winter – December, January, February
- Spring – March, April, May
- Summer – June, July, August
- Fall – September, October, November

Climate Analysis - an analysis of climate factors significant to the SAR program should follow the summary climate statistics area. This is a brief narrative about the climate, weather, and any hazards in the area such as strong tides, seasonal hurricanes, etc. as relative to the marine environment.

4.1.17.6 Major Maritime Disaster

Potential for Major Maritime Disaster - Finally, the environmental scan explores the potential for a major maritime disaster (MMD) to occur in the SAR area. As MMD situations are beyond the sole capacity of the SAR program to respond, these scenarios are explored to better analyze overall risk by consideration of potential risk. As well, these assessments exist to emphasize the need for coordination during these scenarios.

4.1.18 Presentation of Environmental Scan - Initial Stakeholder Consultations

The Environmental Scan will be presented during the initial Stakeholder Consultations, seeking stakeholder input for its update and improvement or concurrence with the completeness and accuracy of the information. As an Annex to the RAMSARD Analysis Report, the revised Environmental Scan will constitute a key part of the Report to management, providing context on the area under review and its characteristics.

4.1.19 Risk Scenarios

In the risk management decision process, risks are described as risk scenarios, which constitute a defined sequence of events with an associated likelihood and range of impacts. The description

will identify a hazard (source of potential harm), the likelihood of a loss occurring, and the potential impact (magnitude of the loss) should it occur.

A simple risk scenario would be described as follows:

> *A sudden winter storm produces an ice build-up on a vessel's deck and superstructure. The risk is that with the added weight on the upper surfaces the center of gravity will change causing control or other issues.*

Within the maritime SAR context, this risk scenario might involve a fishing vessel caught in a storm, capsizing, catching fire, colliding with another vessel or running up on rocks or a shoal. These hazards may individually result in the occupants of the vessel being in the water, and the risks would include drowning, hypothermia or trauma from being washed against a rock or the shoreline.

SAR incident summaries describe such risk scenarios, since they include hazard(s) (e.g. storm with high seas), exposure to the hazard (e.g. fishing vessel caught in a storm) and consequences (e.g. capsized fishing vessel, with occupants in the water or in a life raft and at risk of serious injury or death from hypothermia or drowning). The number of occurrences of each type of risk scenario per year provides a reasonably good estimate of the frequency or likelihood of the occurrence. The range of consequences with which a RAMSARD Analysis is concerned is limited to lives at risk or with definite potential to be at risk if no action is taken.

4.1.19.1 Information Sources

For a RAMSARD Analysis, the sources of information to be used in risk identification will normally be limited to:

- Accident databases (SISAR, SAR Operations Reports, TSB Reports);
- Experience and personal observations garnered from stakeholder consultations; and
- Professional judgement on the part of the Analysis Team

The types of hazards to be considered will include:

- Natural (e.g. weather, sea state, ice conditions, shoals, rocks and shallows, etc.);
- Technical (e.g. vessel size, type, equipment, condition, activity, etc.); and
- Human (e.g. activities, knowledge, skills, behaviour, attitude, decision-making, etc.).

The consequences to be considered are solely limited to health losses (e.g. serious injury or death). Although CCG endeavours to take reasonable measures to protect property, it is not the focus of SAR response resource or service provision. Indeed, consideration of the direct cause of lives being at risk or being potentially at risk in the maritime environment is not relevant to an analysis of SAR response risk. These considerations are important in assessing the effectiveness of prevention programs or targeting education, regulation and enforcement activities, but the reason why an individual is placed at risk in the water is irrelevant to the need for SAR response.

4.1.20 Area Maritime SAR Risk Profile

Using primarily the historical SAR incident data from SISAR, a profile of maritime SAR risk can be created for the SAR area under review. This profile should be developed **relying not only on the**

data itself, but on the experience and knowledge of the Analysis Team. It should be depicted in graphical forms, supported by narrative descriptions, interpretation and analysis, in order to describe the recurring maritime SAR risks in the area and the impact and effectiveness of maritime SAR response delivery in mitigation of those risks.

Table 3 - Incident Classification by Type and Severity*

M - Maritime Incidents (M1, M2, M3, M4) **A** – Aeronautical Incidents (A1, A2, A3, A4) **H** – Humanitarian Incidents (H1, H2, H3, H4) **U** – Unknown Incidents (U4) 1. **Distress incidents** - A vessel or a person is threatened by grave and imminent danger and requires immediate assistance. (Life-threatening situation was judged to be present or close at hand at some point during the incident); 2. **Potential Distress incidents** - The potential exists for a distress incident if timely action is not taken; i.e., immediate responses are required to stabilize a situation in order to prevent distress; 3. **Non-Distress** - A maritime (incident) situation other than an M1 or M2 case, where assistance is rendered to prevent case degradation to greater potential danger. No distress or perceived appreciable risk to life apparent. (General calls for assistance); 4. **False alarms and hoaxes** - Situations that cause the SAR system to react which proves to be unjustified or fabricated, such as a mistaken report of a flare. 5. **Distress Reported After the Fact** – A case that has been resolved but would have required a response had the SAR system been alerted at the time of the case. Will normally be categorized as an **M1P** or **A1P**.

**Note: Incident Classification and Type are defined in accordance with (IAW) the CAMSAR II Manual – Chapter 8.03 Classification of SAR Cases*

The profile should focus primarily on maritime distress and potential distress (M1 and M2) cases. (M3 and M4) cases will be considered in the overall statistics, but will be distinguished from M1, M2 cases in the depiction of all maritime SAR cases in the area.

While the area risk profile developed from the SISAR incident database will likely include most of the commonly occurring maritime SAR incident scenarios, some of these scenarios might lack representation in the five-year span of the data, owing in part to differing levels of maritime activities and differences in the environmental characteristics in the area under review. Likewise, somewhat rare or very rare scenarios, such as major incidents, will probably also be absent in the data (these may also be absent from national incident data owing to their rarity).

In these cases, an assessment needs to be made as to whether there exists any discernible likelihood that the scenario could occur in the area. If so, the frequency, range of possible consequences and whether the existing SAR response capabilities are adequate to deal with the

risk would need to be assessed. For the very rare, major SAR incident scenarios, the potential for occurrence and the consequences will be assessed. In the case of major SAR incident response, the role of area primary SAR resources would be to establish initial on-scene coordination and communication pending arrival of resources (e.g. vessels) with greater endurance and more capability to discharge these functions as part of a whole-of-government response.

As with the Environmental Scan, the basics of the risk profile of the area will be presented to stakeholders during consultations, seeking their concurrence and any additional information or input they may wish to offer. It may be useful to prepare this presentation in Power Point format to facilitate its sharing and discussion with stakeholder groups. As with the Environmental Scan, the risk profile information will also be included as an Annex to the RAMSARD Analysis Report to management. We suggest the following information be included, but other information can also be added:

- Map depicting the SAR Area under review;
- Series of (5) maps showing maritime SAR incident locations by year for the 5-year period under review and distinguishing class of M1, M2 incidents versus others;
- Bar graph showing 5-year average monthly M1, M2 incident distribution;
- Bar graph showing seasonal distribution of M1, M2 incidents by year;
- Bar graph showing 5-year seasonal distribution of M1, M2 incidents;
- Bar graph showing average response time (tasked to on-scene) for all cases by year and by category of resource (primary, secondary, other [includes CCGA], civilian);
- Bar graph showing average response times (tasked to on-scene) for M1, M2 incidents by year and by category of resource (as above);
- Map showing area boundaries and radius of action for CCG primary SAR resources serving the area with statement describing radius (in NM) and any seasonal limitations as applicable; and
- Map showing area boundaries and radius of action (from home port) for CCGA SAR resources serving the area, with statement describing radius (in NM) for various types of CCGA resources and seasonal limitations as applicable.

Additional graphics may be prepared to depict the following information:

- Breakdown of incidents by activity of the vessel involved (pleasure boating, fishing, commercial, marine transportation); and
- Annual historical M1, M2 incident statistics for previous five years: incident numbers, lives saved, lives lost, lives at risk, 5-year totals, average lives at risk and average lives lost per year.

The presentation of this information to stakeholders will be used to stimulate discussion during the consultations, seek their input as to the nature of SAR response risks in the area and assist in the Stakeholder Analysis. It is important to recognize the consultations as an opportunity to shape stakeholder understanding of their own roles and responsibilities with respect to undertaking activities in the maritime environment and how and where CCG maritime SAR response capabilities fit in the scheme of maritime SAR risk mitigation.

4.1.21 Stakeholder Analysis (Preliminary)

A Stakeholder Analysis is an integral part of the risk communication process, and it is one of the most useful tools incorporated within the CAN/CSA-ISO 31000-10 Risk management - Principles and Guidelines (*which has superseded (CSA) standard Q850-97*) risk management decision framework. The Stakeholder Analysis provides the decision-maker with a documented profile of stakeholders which helps to develop more effective communications and consultations.

A Stakeholder Analysis is essentially a survey of stakeholders to identify:

- Who they are;
- Whether or not they are at risk, and whether they understand their exposure;
- Their level of interest regarding the issues under consideration;
- Their objectives, needs, issues, and concerns (what matters to them);
- Their knowledge regarding issues under consideration (and any knowledge gaps);
- Any misperceptions they might have;
- Who they trust to provide them with information;
- The types of communication processes that they might favour; and
- Other information relevant to the decisions at hand.[2]

It should be noted that as a stakeholder, the decision-maker should also be subject to this Stakeholder Analysis. This means that information related to the needs, issues, concerns, and knowledge gaps of the decision-maker's organization should also be documented.

Conducting a Stakeholder Analysis with the stakeholders present, helps build trust in the process and goes a long way to providing improved insight for all participants. Improved insight into risk issues, on the part of all stakeholders, is an ultimate objective of the risk communication process.

When dealing with risk issues, where concern is high, and trust is low, effective communications and consultations among stakeholders are essential for building support for government policies and actions. The Stakeholder Analysis also provides an excellent tool for ensuring that communications and consultations are focused and effective.

Along with presenting the Environmental Scan and Area Risk Profile to stakeholders, the Analysis Team should document stakeholder comments and input for adjustment of this information as well as further analysis of stakeholder perceptions and concerns. Notes taken of significant stakeholder comments will be included as an Annex to the RAMSARD Analysis Report to management.

4.1.22 Preliminary Analysis

Not all risks will necessitate an elaborate, detailed analysis. For some risks, informed judgments can be made with only a simple but detailed analysis of readily available information. If a risk is comparable to one that has already been dealt with successfully, a similar solution can be readily

[2] CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines *(which has superseded (CSA) standard Q850-97)*.

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considered. This is often the case when examining the risks dealt with by maritime SAR response services, since in a given year, most maritime SAR risk scenarios will be represented within the incident statistics of the SAR system. Those statistics will include an indication of likelihood of occurrence as well as consequences (i.e. how many lives at risk or potentially at risk).

The purpose of the Preliminary Analysis is to define the basic dimensions of the risk and to undertake an identification, analysis, and evaluation of potential risks. **This is basically a high-level risk management process with limited analysis and consultations and using mostly readily-available information.**

A Preliminary Analysis results in a determination that either:

- An emergency or other situation exists, and corrective action should be taken immediately (given the ongoing communication, consultation and self-evaluation in the maritime SAR system, it is unlikely that a situation requiring immediate action would not have come to light prior to a RAMSARD Analysis); or
- There is a need to undertake a more detailed analysis (e.g., where management wishes to consider adjustments to SAR response resource allocation in the area, or existing CCG and other SAR response resources serving the area are proving incapable of collectively meeting CCG Performance Standards); or
- The Analysis should be ended here if the risk is determined not to be a risk problem.

In the case of a routine, 5-year RAMSARD Analysis, it will be considered that there is no risk 'problem' to be addressed when it is determined that SAR response services in the area under review:

- Are meeting the CCG Performance Standard for existing risks, based on historical incident analysis;
- Are being efficiently employed; and,
- Are assessed as being capable of mitigating known or expected future risks, including rare event risks such as major SAR incidents, within the expected parameters (i.e. on-scene coordination only).

Under RAMSARD, analysts should first perform a Preliminary Analysis to determine whether a more detailed analysis is required. It should be noted that a Preliminary Analysis is useful on many levels: the information it captures can form the basis for more detailed study, if such is required.

Here are some considerations when deciding whether to conduct only a Preliminary Analysis or a more detailed analysis:

- A Preliminary Analysis may be the only practical alternative if decisions are required immediately;
- A more detailed analysis may be required if there are legal considerations associated with a particular decision situation (e.g., a change to federal government commitments in support of an area or activity;

- More analysis may be prudent if there is substantial media or public interest in the situation (e.g., maritime incident fatalities have increased in the area in relation to a new or riskier activity); and
- More analysis may be prudent if the potential consequences of the decisions are significant (e.g., a decision to remove a SAR response resource without replacement).

The goal of the analysis process is to provide sufficient information so that decisions can be made with confidence. For the sake of efficiency, decision-makers should consider carefully how much analysis is sufficient for the decisions at hand. A detailed Preliminary Analysis will often suffice.

The Preliminary Analysis can identify those known maritime SAR risks that are being satisfactorily mitigated by the SAR system as a whole and assess the effectiveness of the CCG contribution to that mitigation. At that point, those risks mitigated need not be further considered in the process unless the stakeholder consultation reveals information pertaining to those risks that is not included in the SISAR data and that may impact existing mitigation measures or require the consideration of new ones.

The steps of a detailed Preliminary Analysis are listed below. Of note, these steps will also constitute the section headings in the RAMSARD report to management prepared following an Analysis.

4.1.22.1 Preliminary Analysis: Incident Data Review and Analysis

This step uses the five-year historical SAR incident data from SISAR to ascertain what risks existed in the area under review. Risk scenarios considered in this step are those that involved consequences of serious injury or loss of life and those which had the potential to develop into scenarios with such consequences (M1, M2). Aspects to be analyzed and considered include:

- Yearly rates of M1, M2 incidents;
- Seasonal distribution of incidents (and causes);
- Monthly distribution of incidents by year and averaged for the five years of data;
- Incident types (e.g. fire, capsizing, etc.) by category and distance from shore (inshore, offshore, remote);
- Incident type breakdown by proportion of each type; and
- Incident distance from shore for all incidents and for M1, M2 incidents only

Graphics such as bar and pie charts should be used as appropriate and accompanied by narrative description and analysis. Incident types not represented in the data should be noted in the narrative as to potential likelihood of occurrence in the area, with an assessment of the existing SAR response resources to deal with them.

4.1.22.2 Preliminary Analysis: Meeting the CCG Performance Standard

The data should be used to assess whether the CCG Performance Standard of 90% of lives at risk saved is being met on a yearly basis and on an average over the five-year review period. If it is not met, reasons why should be explored. SISAR SAR incident summaries for cases with fatalities should be analyzed to determine whether or not lives were lost before the SAR system

was alerted or, as best can be determined, with no reasonable opportunity for intervention by SAR responders.

Lives at Risk = Count of lives (Assisted + Saved + Lost + Missing)

CCG Performance Standard of 90% is based on the percentage of lives saved out of the total number of lives at risk.

As defined in the Canadian Coast Guard Level of Service - Service Standards, June 2004 - 90% effectiveness is expected to be achieved during "conventional incidents" in which:

a. resources are able to respond within a short period of time;

b. the search object is located by the responding resource on scene in a timely manner;

c. environmental, geographic, and hydrographic conditions have little impact on the successful resolution of the incident; and

d. the responding resource has the necessary capability and capacity to effectively resolve the incident.

When assessing SAR performance, it has long been CCG policy to include in the statistics all lives lost in maritime SAR incidents, regardless of when they were lost or whether or not there was any reasonable opportunity for SAR responders to save those lives. The argument in favor of this approach is that such inclusion better measures SAR system performance, which includes activities unrelated to SAR response such as prevention. In contrast, in making assessments of the effectiveness of SAR response services alone, the International Maritime Organization (IMO) does not include lives lost before system notification or where it can be determined that no reasonable opportunity existed for successful intervention by SAR responders. Indeed, IMO points to studies that suggest that up to one third of fatalities in maritime SAR incidents occur very shortly after system notification, leaving no reasonable probability of successful intervention by SAR responders.

Therefore, in consideration of the limitation of RAMSARD Analysis application to SAR response delivery versus SAR system assessment, it is reasonable to apply the IMO approach when assessing lives lost and CCG's results with regards to its Performance Standard. The Analysis of SAR incident summaries, together with SMMS case files, SAR Operations Reports and TSB Accident Reports as necessary, should be documented to substantiate numbers of fatalities adjusted for this purpose.

4.1.22.3 Preliminary Analysis: Resource Response Times in Incident Resolution

Response time is defined as the time from which the 'SAR system alert' is received, until, a SAR resource arrives on scene at an incident location or search point. Because of the size of Canada's maritime SAR Regions and the variability in environmental conditions, particularly sea conditions, visibility and the potential presence of sea ice or icebergs, CCG does not use response times as a measure of SAR response performance. Nevertheless, a broad consideration of collective average response times for all resource types and categories in a SAR Area is useful in understanding the availability of SAR response resources and their ability to

cover the area in reasonable time. It is further useful for the information of stakeholders, particularly client groups, to emphasize the need to prepare and equip to survive in the water long enough to permit a reasonable chance of successful rescue.

Yearly SAR system average response times for the area should be computed from the SISAR data and depicted in bar graph format for all categories of incidents and separately for M1 and M2 incidents. Analysts should assess significant variations among the years and/or trends and seek to identify possible explanations, particularly where trends are negatively oriented (e.g. longer response times). A narrative should accompany the depictions and explain variations.

4.1.22.4 Preliminary Analysis: CCG Primary SAR Vessels and SAR Incident Response

The specific involvement of CCG primary SAR vessels assigned to or serving the area under study should be assessed for M1, M2, and M3 category incidents. M3 incidents should be included since CCG and CCGA resources are often tasked to respond to these incidents, which, while not constituting a distress or potential distress situation, may ultimately degrade into these categories without timely assistance being provided.

SISAR data and incident summaries as well as SMMS case logs should be consulted to determine the number of cases in each category for which CCG primary SAR vessels were the means of rescue. In this regard, it is important to distinguish between the tasking of CCG vessels and their role as the resource carrying out the rescue. For M1 cases, a large number of resources of varying types are tasked to respond, since timeliness is more important than economy, effort or resource category. Therefore, CCG primary SAR vessels are often not the means of rescue in these cases. In M2 cases, since the JRCCs lack the authority to compel nearby vessels to respond, they most often task CCG, CCGA and/or other federal government vessels, which will therefore be more likely to be the means of rescue. This likelihood is increased where response to M3 cases are concerned.

Often the result of mechanical breakdown, M3 incidents are normally reacted to by the SAR system through the issuance of a Marine Assistance Radio Broadcast, seeking assistance from any willing nearby and capable vessel. For non-distress cases, nearby vessels cannot be directed to assist. Following the issuance of the Marine Assistance Radio Broadcast and under reasonably fair weather and sea conditions, the situation is simply monitored, awaiting notification from the affected vessel or an assisting vessel that the situation is being or has been resolved. Impending nightfall or worsening weather and sea conditions, if the M3 case is not yet resolved, CCG or CCGA vessels will often be dispatched to provide the necessary assistance (such as a tow to a safe anchorage or harbour). This prevents degradation of the situation to a distress or potential distress category and reduces risk to responders by resolving the incident under safer and more favourable conditions. Thus, the role of CCG primary SAR vessels in M3 category incident resolution should be considered in the context of a reduction or avoidance of M1 and M2 cases with associated reduction in lives at risk.

A graphical depiction should be prepared, showing the proportion of M1, M2 and M3 incidents responded to by CCG primary SAR vessels in or serving the area under review, accompanied by a narrative describing the contribution in percentage by each CCG primary SAR vessel.

4.1.22.5 Preliminary Analysis: Major SAR Incident Risk

The area should be assessed as to the potential for occurrence of a major SAR incident (such as one involving a vessel or large aircraft over water) and the adequacy of primary, secondary and other response capabilities in the area to deal with such occurrence. Response to major SAR incidents is the focus of specific, major SAR incident plans developed and maintained within each SAR Region. The scale of consequences in terms of numbers of lives at risk during a major SAR incident dictates that response to such incidents will almost always involve a whole-of-government approach. Given the range of circumstances and the rarity of occurrence of major SAR incidents, no jurisdiction or specific agency can be expected to maintain adequate resources to unilaterally deal with such response.

Owing to their alert posture, CCG primary SAR vessels in proximity to a major SAR incident as well as RCAF primary SAR aircraft serving the affected area will be tasked for initial response while all other possible capabilities are identified and brought to bear. The priority for this initial response will be the provision of on-scene communication and coordination of response activities by follow-on resources.

4.1.22.6 Preliminary Analysis: Summary of Incident Data Review and Analysis

At this point, the results of the review and analysis of incident data are summarized into conclusions, based on the characteristics of the hazards, risks and incidents in the area: types of incidents, proximity to shore, activity of vessels involved in incidents, lives lost versus lives at risk rate. A conclusion should also be stated regarding the adequacy of capabilities serving the area to deal with major SAR incident risks. Most importantly, a conclusion as to whether or not the CCG minimum Performance Standard has been met, both on average over the study years and by individual years, with the following caveat: where the response capabilities had a reasonable opportunity to intervene.

4.1.22.7 Preliminary Analysis: Stakeholder Consultations

This step consists of summarizing the main points raised during stakeholder consultation sessions, while the complete notes taken during the consultations should be included as an Annex to the Preliminary Analysis Report. Any issues or areas of heightened concern on the part of stakeholders should be highlighted for additional investigation and analysis. Often, stakeholders' concerns will reflect perceived heightened levels of risk rather than entirely new risks. The results of investigation and analysis of these concerns should be shared with stakeholders in follow-on consultations, along with proposed action to mitigate any heightened risks.

4.1.22.8 Preliminary Analysis: Analysis of Stakeholder Input and Concerns

Stakeholder input and concerns should be analyzed and compared to the assembled historical incident statistics. Explanation of any significant discrepancies should be sought and would be a topic for follow-on consultation with stakeholders, either to seek further details or to respond to the original concerns raised. At times, stakeholders might share concerns that have little to no direct bearing on SAR response provision but are reflective of issues that may lead to increased

demand for SAR response if unresolved. For example, in certain circumstances, rigid fishery opening dates, irrespective of prevailing weather and sea conditions, may be perceived as incentives for risky behaviour by individuals in a competitive fishery.

In cases such as these, the details should be noted for later consideration as to whether any SAR response risk mitigation or recommendation to the appropriate party for action is required. Critical to such consideration is the recognition and acceptance of the responsibility associated with the risks, as SAR response (risk mitigation) is much less effective than risk avoidance.

4.1.22.9 Preliminary Analysis: Conclusions

This step in the detailed Preliminary Analysis speaks to the following three possible determinations.

- The first possible determination, that a situation exists that requires immediate action, owing to the ongoing communication, consultation and self-evaluation inherent to the SAR system.
- The second possibility is a determination that a more detailed analysis is required because management has directed consideration of alternate response resource configurations in the area or the existing SAR response resources are proving recurrently inadequate to meet the CG minimum Performance Standard. In this case, the risk scenarios developed, along with their historical likelihood of occurrence and range of consequences to life as determined from SISAR data, will form the basis for such further analysis, following the process outlined in the succeeding RAMSARD Sections under Risk Estimation, Risk Evaluation, Risk Control and Action and Monitoring.
- The third possible determination, is that no risk problem exists in the area under review. This means that SAR response services in the area under review are meeting the CCG Performance Standard for existing risks based on historical incident analysis; are being efficiently employed; and are assessed as being capable of mitigating known or expected future risks, including rare event risks such as major SAR incidents, within the expected parameters (i.e. on-scene coordination only).

With the third type of determination, the Analysis should be ended and a Report to this effect prepared for management review and acceptance. A summary of conclusions should be prepared under the following headings:

- Effectiveness: A section on the achievement of the CCG minimum Performance Standard and the degree of involvement by CCG primary SAR vessels assigned to or serving the area, in terms of numbers of responses for M1 and M2 incidents as well as their role in resolving M3 incidents;
- Efficiency: A section on cost-benefit financial terms, the value of the contribution by CCG primary SAR vessels to the saving of lives at risk and lives potentially at risk in the area using Treasury Board's value of a statistical life figure of $6M and attributing full-value for lives saved in M1 incidents and a recommended attribution of only 10% value for lives saved in response to M2 incidents. No value should be attributed to lives (persons on board vessels) in M3 incidents to which CCG primary SAR resources responded.

The total value of lives saved should be compared to the estimated costs of the provision of the CCG primary SAR vessel (personnel, operations and maintenance for vessel, infrastructure and fuel) to assess a measure of the efficiency of CCG primary SAR vessel use in the area.

New Risks/Residual Risks: A section describing any new or heightened risks identified, whether or not these are risks best mitigated at the SAR response level and whether or not the existing SAR response resources serving the area are capable of mitigating these risks to an acceptable level (i.e. maintaining CCG minimum Performance Standards).

4.1.22.10 Preliminary Analysis: Recommendations

This final step in the Preliminary Analysis seeks CCG management concurrence and acceptance of the findings and may include recommendation(s) for action by management with respect to SAR response delivery or to other aspects of the SAR system such as prevention, education, regulation and enforcement that could be referred to responsible organizations.

NOTE: A final stakeholder consultation or communication should be undertaken to inform stakeholders of the outcome of the Preliminary Analysis and decisions taken or recommendations being made with respect to issues or concerns they have raised. **It is not necessary that stakeholders agree with the results of the analysis or the actions proposed and recommended, but it is important that they understand the process by which these determinations were made.**

The following pages contain a sample guide for initial stakeholder consultation and a checklist to record completion of Risk Identification and Preliminary Analysis tasks.

4.1.23 Initial Stakeholder Consultation Guide

Stakeholders are given a copy of environmental scan information on the SAR Area to review and are asked if they have any comments or questions, or if there is additional information they feel is pertinent in accurately describing the geography and demographics of the area, with emphasis on the maritime environment and activities.

They are shown several Power Point slides that depict historical statistics and data on SAR incidents that occurred in the area over the previous five years. Commentary by Team members will speak to seasonal distribution of incidents, proximity to shore of incident occurrence, response times and preparedness measures for individuals to survive for at least as long as the response time.

Depending on the level of engagement by the stakeholders, the following points may be raised in leading question examples to stimulate discussion:

- Having viewed the graphs on seasonal distribution and incident locations, do you feel that there are any trends or reasons to explain the incident distribution?
- What high and low risk maritime activities (if any) occur in the area?
- In your opinion, has the level of SAR risk increased, decreased or remained unchanged over the past five years? Why do you think so?

- How do you feel about the degree to which the maritime risks identified are being addressed by all parties: CCG, Regulatory (e.g. TC), Enforcement (e.g. RCMP), and mariners)?
- How do you think risks associated with maritime activities in this area can be effectively managed?
- Are you aware of all the SAR response resources available to serve the area? Do you feel that there are sufficient SAR resources to manage the risk in this area? Why, or why not?
- If you were to experience a maritime emergency, how would you activate the SAR system?
- Do you perceive a trend that mariners in the area are better equipped and trained to deal with an onboard emergency than they were five years ago? What influences your opinion?
- How do you view the responsibilities of individuals involved in maritime activities to prepare themselves (e.g. training, equipment, vessel condition, decision-making), to operate safely in the marine environment and to deal with emergencies that occur, including being able to survive long enough and assist in being rescued?

Table 4 - Risk Identification Checklist

Scope of Analysis Defined?	Yes - No
Environmental Scan Prepared/Updated?	Yes - No
Risk Scenarios Developed?	Yes - No
Area SAR Risk Profile Developed and Presentation Prepared?	Yes - No
Initial Stakeholder Consultation and Analysis Conducted?	Yes - No
Preliminary Analysis Completed?	Yes - No
Preliminary Analysis Decision?	End Analysis/Further Analysis
Follow-on Stakeholder Consultation and Communication?	Yes - No - N/A

4.1.24 Risk Identification Documentation Requirements

A detailed description of each risk scenario needs to be provided, including who raised the issue, why is it an issue for them, what is their level of concern regarding the issue, whether addressing the issue is within the scope of CCG's mandate, etc.

More specifically, the following should be documented:

- Details related to each risk scenario, including a description of the event, its associated consequences and any related assumptions being made;

- Details related to any analyses undertaken to identify risk scenarios, description of how risks were identified (e.g. through analysis of SISAR incident data, expert judgement of the Analysis Team, environmental scan);
- Details of any communications or consultations with stakeholders related to the identification of risks;
- Updated stakeholder analysis, or initial stakeholder analysis if one has not previously been done;
- Details related to privacy issues, if any, related to the data or to stakeholder analyses; and
- Details of any decisions taken, including reasons for dismissing issues, objectives related to any further analyses (if further analyses are required).

If the recommendation is to end the study at the Preliminary Analysis stage, the reason for doing so must be explained. This will be included in the RAMSARD Analysis Report prepared at the end of a Preliminary Analysis, if it is deemed to satisfy the requirements of the mandated study.

4.1.25 Risk Identification Process

Create Stakeholder Analyses

- Begin Stakeholder Analysis, consultation and information gathering.

Commence Initial Round of Consultations

- Gauge level of interest and issues.
- Seek insights, perspective and information otherwise not available.
- Consult as to accuracy of weather conditions to ensure key aspects are identified.
- Consult as to user profiles - accuracy of data.
- Gain consensus regarding estimates (e.g. pleasure craft volume).
- Identify probable future trends.

Share SAR Incident Data with SAR Partners and Clients

- Focus on information that is most relevant to these groups (e.g. response times for partners, incident trends if identified, how lives are lost).
- Verify whether data is consistent with expectation of SAR service.
- Share information at in-person presentations to consultation groups or individually by other means.

Update Stakeholder Analyses

- Ongoing throughout process, whenever new information obtained from stakeholder.

Determine if RAMSARD Process Ends

- If risks are satisfactorily mitigated, or judged to be acceptable, recommend ending process.
- If appropriate, recommend that process carry on to Phase III.

- The Decision-Makers make the final determination, taking into account your recommendation.

4.1.26 Risk Identification - Template(s)

Create Stakeholder Analyses

- Step 2 Stakeholder Analyses.docx (incl. "Contact History" field)

Commence Initial Round of Consultations

- Step 2 Risk Scenarios (to capture info gathered from stakeholders)
- Request for Input (RFIs) – specific to target group (completed RFIs returned from stakeholders)
- Step 2 Initial Stakeholder Consultation Guide
- Step 2 Risk Identification Checklist

Share SAR Incident Data with SAR Partners and Clients (Materials to Show Stakeholders)

- Intro to RAMSARD 2018-03-19
- Step 2 Environmental Scan
- Step 2 Area Maritime SAR Risk Profile
- Other documentation as required.

Update Stakeholder Analyses

- Stakeholder Analyses (incl. "Contact History" field)

Commence Preliminary Analysis

- Step 2 Preliminary Analysis

Determine if RAMSARD Process Ends (If risks are satisfactorily mitigated, or judged to be acceptable, recommend ending process. If appropriate, recommend that process carry on to Step Three (3). The Decision-Makers make the final determination, taking into account your recommendation)

- No template available

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

STEP THREE - RISK ESTIMATION

4.1.27 General

This step provides the methodology used to estimate the frequency (Probability) and consequences, including a description of any data utilized to the analyses.

4.1.28 Purpose

For RAMSARD applications where a Preliminary Analysis determines that further analysis is required, either because of management direction to consider alternative CCG SAR response resource configurations or because existing SAR response capabilities have proven recurrently inadequate in meeting the CCG minimum Performance Standard, the area risk scenarios will undergo Risk Estimation to:

- Estimate the likelihood of the previously identified risk scenarios occurring; and
- Estimate the range of consequences associated with each scenario.

4.1.29 Scope

The first decision to be made is to determine the methodology that will be used to estimate the likelihood and impact of the risks. For example, will estimates be based on historical data, models, professional judgement, other forms of technical analyses, or on a combination of methods? **In the case of a RAMSARD Analysis, historical data (SISAR incident data) and professional judgement will be the basis of the methodology.** Industry accident rate estimates and environmental scan activity data for ferries, cruise ships, cargo vessels, airliners, etc. will supplement the SISAR data for rare, major SAR incidents.

NOTE: Although SISAR data is considered suitably accurate only post-2008, the period of historical data will increase with time, and so will the validity of that data in representing the best estimate of likelihood and range of consequences.

4.1.30 Communications and Consultation - Risk Estimation

- To engage stakeholders and partners in assessment of status of SAR Delivery;
- Consult with partners as to accuracy of SAR capacity and coverage factor (availability and response time estimates) and verify whether these are consistent with historical SAR incident data;
- Consult with stakeholders (SAR Program expertise, CCG Operations, CAF, CCGA, other local resources) as to accuracy of SAR Capability Matrix; and
- Consult as to the final estimations for the area.

4.1.31 Risk Estimation Planning

If the level of interest or concern is high, or if credibility with key stakeholders is low, the chances of decisions being challenged increase. If estimations or results might be challenged, it will be necessary to describe in detail how the associated likelihood and impacts were determined. Defining the methodology is also necessary to avoid conflict between technical experts and laypersons when evaluating the results of such analyses.

The choice of method will reflect timing, resources, availability of data, the need for accuracy or the possible need for some statistical portrayal of the data, and the acceptance of the methodology by key stakeholders. An additional consideration is that the uncertainties associated with estimates, as well as the assumptions included in the analyses, should be clearly stated. A third-party review may be considered if we need to lend greater credibility to the results.

Before moving on to the next step Risk Evaluation, these questions should be answered:

- Are the uncertainties associated with the estimates acceptable? Can decisions as to the acceptability of the risks be made comfortably based on these estimates, given their associated uncertainties?
- Was the data used in the Analysis adequate, or does more precise data need to be acquired (at an additional cost in dollars and time)? Is more precise data available? Would acquiring more precise data affect the decision?
- Is the methodology used for the Analysis appropriate? Should the Analysis be redone using a different method?
- Do the estimates of likelihood or impact raise any new issues with the Analysis Team or with stakeholders? This could occur if the estimates turn out to be far higher than expected.
- Have any new risks been identified as a result of these analyses?
- Has the scope of the overall analysis changed?

The key question is: **"Is the Analysis Team comfortable making recommendations based on the information now in hand?"**

Note: Any completed stakeholder analyses may need to be revised in light of new information. Is the level of concern the same, given that stakeholders now have a better idea of the likelihood and impact of the risk situations? Is the level of concern on the part of the Analysis Team the same? Concerns may have changed because of the Analysis, perhaps calling for a change in approach.

Table 5 - Risk Estimation Checklist

Are the uncertainties associated with the estimates acceptable?	Yes - No
Was the data used in the Analysis adequate, or does is more precise data needed (at an additional cost to obtain)?	Yes - No
Is more precise data available? From whom?	Yes - No
Would acquiring more precise data affect the decision?	Yes - No
Is the methodology used for the Analysis appropriate?	Yes - No

Should the Analysis be redone using a different method?	Yes - No
Do the estimates of likelihood or impact raise any new issues with the Analysis Team or with stakeholders?	Yes - No
Have any new risks been identified because of these analyses?	Yes - No
Has the scope of the overall analysis changed?	Yes - No - N/A

4.1.32 Risk Estimation Documentation Requirements

The documentation required for this step should describe the methodology used to estimate the frequency (probability) and consequences, including a description of any data utilized in the analyses. It should include:

- Details of the assumptions made in the analyses;
- Results of the analyses;
- Details of the uncertainties (statistical and other) associated with the estimates;
- Reasons for decisions, if it decided that more analysis is required (e.g., the uncertainties associated with the estimates are considered too large); and
- Updated Stakeholder Analysis.

4.1.33 Risk Estimation Template(s)

Step 3 Risk Estimation

- Step 2 Risk Scenarios (update Risk Scenarios from stakeholders for new information)
- RFIs (update RFIs from stakeholders if new information obtained)
- Step 3 Analyses to Complete
- Step 3 Risk Estimation Elements
- Step 3 Risk Estimation Matrices

Materials to Show Stakeholders

- SAR Capacity Matrix
- SAR Capability Matrix
- Area Coverage Maps
- Other documentation as required.

Update Stakeholder Analyses

- Step 3 Updated Stakeholder Analyses (incl. “Contact History” field)

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

STEP FOUR - RISK EVALUATION

4.1.34 General

In this step of the process, an evaluation will be conducted to assess whether the risks are acceptable or not, in terms of the benefits of the activities leading to the risks and in terms of the expressed needs, issues, and concerns of affected stakeholders (including the CCG).

A decision will be made with respect to the acceptability (or not) of the identified risks. It can be beneficial to give decision-makers a summary of what is known at this stage, as well as what is not known, to aid in their making a decision about whether a risk(s) is acceptable; whether some form of risk control needs to be applied, or whether there is a need for more information before such decisions can be made such as:

- Details related to any stakeholder consultations undertaken regarding the evaluation of risks and benefits.
- updated stakeholder analysis.
- Reasons for decisions taken in respect of the acceptability of the identified risks.

Note: These are key decisions and should be adequately documented.

4.1.35 Purpose

So far in the Analysis, only the risks (or expected losses) associated with the activity have been considered. Before deciding about the acceptability of the risks, the benefits associated with the activity leading to the risks need to be considered. Decisions hinge on the trade-off between the benefits and the risks. The risks may be acceptable if the benefits are sufficient.

A summary of all risks (scenarios), estimates (risks, benefits, costs), and stakeholder objectives (needs, issues, concerns), in the form of an executive summary for decision-makers.

4.1.36 Scope

This evaluation will help determine whether:

- The identified risks are acceptable, so the activity proceeds without any need for further mitigation;
- The identified risks are not acceptable at any level; or
- The activity might be acceptable, but risk mitigation measures should be applied to reduce the risk to a lower level or, if possible, benefits of the activity should be increased.

If the risks are considered acceptable at their current level, the Analysis can be ended, although the situation will need to be monitored for possible future changes. If the risks are deemed unacceptable at any level and if the activity is not mandatory or can be avoided, then the activity may need to be abandoned. This would end the decision process.

If the activity is deemed acceptable if the risks can be reduced or the benefits increased, the process moves on to the next step of identifying and evaluating alternative mitigation strategies.

Note: There may be a need to return to previous steps if the data is deemed insufficient for making these decisions, or if new issues or risks have been identified.

4.1.37 Communications and Consultation - Risk Evaluation

- To gain input into stakeholder perception and assess stakeholder acceptance of risk; identify and document stakeholder issues; and
- Hold broader and deeper consultations with relevant documentation for higher risk, more complex circumstance or probable controversial outcome (e.g. reallocation of resources).

4.1.38 Risk Evaluation Planning

A summary of all risks (scenarios), estimates (risks, benefits, costs), and stakeholder objectives (needs, issues, concerns), in the form of an executive summary for decision-makers should be formulated.

Note: At this step a decision will be made with respect to the acceptability (or not) of the identified risks. It can be beneficial to give decision-makers a summary of what you know at this stage, as well as what you don't know, to aid in their making a decision about whether a risk(s) is acceptable; whether some form of risk control needs to be applied, or whether there is a need for more information before such decisions can be made such as:

- Details related to any stakeholder consultations undertaken regarding the evaluation of risks and benefits.
- Updated stakeholder analysis.
- Reasons for decisions taken in respect of the acceptability of the identified risks.

Note: These are key decisions and should be adequately documented.

Table 6 - Risk Evaluation Checklist

Region / SAR Area Identified?	Yes - No
Results of Analyses Documented?	Yes - No
Details of the Assumptions Made in the Analyses Complete and documented?	Yes - No
Summary of Analyses and Reasons is complete and documented?	Yes - No
Details of the Uncertainties (Statistical and Other) Associated with the Estimates is documented?	Yes - No

For additional guidance please see "RAMSARD Manual", Sect. 4.1

4.1.39 Risk Evaluation Documentation Requirements

The documentation for this step should include an executive summary for decision-makers of all risk scenarios, risk estimates (benefits, costs, etc.), and stakeholder objectives (needs, issues, concerns).

At this step, a decision will be made with respect to the acceptability of the identified risks. It can be beneficial to give decision-makers a summary of what is known at this stage, as well as what remains unknown, to aid in their making a decision about whether a risk is acceptable; whether some form of risk control needs to be applied; or whether there is a need for more information before such decisions can be made. Information provided should include:

- Details related to any stakeholder consultations undertaken regarding the evaluation of risks and benefits; and
- Updated stakeholder analysis.

4.1.40 Risk Evaluation Template(s)

Step 4 – Risk Evaluation Engagement

- Step 4 Updated Stakeholder Analyses (incl. "Contact History" field)
- Risk Scenarios (update Risk Scenarios from stakeholders with new information)
- Step 4 Executive Summary
- Step 4 Summary of Analyses and Reasoning

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

STEP FIVE - RISK CONTROL

4.1.41 General

In this step of the process, alternative means for reducing the likelihood or the impact of the risk scenarios (developed during Risk Identification) need to be identified and evaluated.

One of the problems in decision-making in general is the tendency to look only at readily-available or familiar solutions for dealing with risk issues. There is a need for creativity in order to identify a broader range of options that might help better achieve risk management objectives. There are several tools available to aid in this effort, for example means-ends networks, decision trees, and facilitated groups.

4.1.42 Purpose

The purpose of this step is to identify feasible alternatives (risk control options) for reducing expected losses. These risk control options act to reduce either the frequency of the loss or the consequence of the loss should it occur. Risk control options should be evaluated in terms of their cost, their effectiveness in reducing losses and their impact on other stakeholder objectives. The need to evaluate the trade-offs inherent in choosing on control strategy over another is based on their overall impact on objectives.

4.1.43 Scope

There are six broad types of strategies for reducing risk:

- Avoid the exposure to risk altogether. The only way to reduce risk to zero is to either eliminate the hazard generating the risk or eliminate exposure to that hazard. The maritime environment represents a hazard in itself, even under favourable weather and sea conditions; human beings are not naturally aquatic creatures and need support measures to survive in that environment. Risk avoidance is the goal of prevention programs;
- Put in place measures that will reduce exposure to the hazard. This is a degree of risk avoidance;
- Put in place measures that will reduce the frequency (likelihood) of the loss occurring, such as lifeboats and life jackets. This is considered risk management or control;
- Put in place measures that will reduce the consequences (impact) of the loss if it does occur. SAR response seeks to do this by saving lives at risk in SAR incidents;
- Duplicate assets; and/or
- Transfer the obligation to deal with a risk situation to someone else.

There is usually more than one risk-reducing option available to deal with a risk situation, and multiple strategies may need to be implemented to reduce the risks to an acceptable level.

Once alternative measures for mitigating the risks have been identified, they need to be evaluated in terms of their effectiveness in reducing the risks and their impact on other objectives (including cost).

In a maritime environment context, total risk avoidance would mean not going out onto the water at all. This solution would be 100% effective in avoiding involvement in a maritime SAR incident, but completely impractical for those who make their living on the water. A measure to reduce, but not eliminate, exposure to the hazard of being on the water would be to avoid venturing out when adverse weather or sea conditions exist or are forecast. This is more practical than the first option, but sometimes requires a trade-off between earnings level and risk to personal safety.

4.1.44 Communications and Consultation - Risk Control

- To involve stakeholders in identification and evaluation of risk control options; and
- Assess stakeholder acceptance of residual risk.

4.1.45 Risk Control Planning

This risk management process is designed to provide decision-makers with information about the trade-offs that arise in choosing amongst alternative courses of action, including alternative resource configurations. However, it does not tell decision-makers which option(s) to choose or what to value. The job of the analyst is to identify the range of options and provide decision-makers with relevant information about the trade-offs inherent in choosing amongst the options.

Before a risk control strategy has been decided upon, analysts need to assess how effective this control strategy could be in reducing the risk and how much risk would remain after it is implemented (this is called residual risk). Once the residual risk is estimated, its acceptability will need to be assessed through a return to the Risk Evaluation step.

If the residual risk is acceptable, the Analysis can be ended, but the situation should still be monitored. If the residual risk is unacceptable, alternative or increased mitigation measures will need to be considered. It is better to add control strategies one step at a time, rather than all at once. Otherwise, risks may be reduced more than necessary for it to be acceptable to stakeholders, with more resources than is necessary. The resources that would have been saved might have been be better utilized elsewhere else.

Table 7 - Risk Control Checklist

Determine Risk Control Options and Implementation Plan	Yes - No
Involve stakeholders in identification and evaluation of risk control options.	Yes - No
Assess stakeholder acceptance of residual risk.	Yes - No

4.1.46 Risk Control Documentation Requirements

Documentation for this step should include:

- A description of all control strategies that have been considered;
- A description of any constraints impacting the choice of control measure(s);
- For each considered control measure, details of its expected effectiveness, cost and impact on other stakeholder objectives;
- Details related to any assumptions and uncertainties inherent in the analyses;

- Details of communications or consultations with stakeholders;
- Implementation plan related to risk control strategies, including details of any contracts related to the transfer of authority or financial obligations;
- Monitoring plan; and
- Details of any financial considerations related to residual risk.

4.1.47 Risk Control Template(s)

- Step 5 Stakeholder Communications
- Step 5 Assumptions & Uncertainties
- Step 5 Implementation & Monitoring Plan
- Step 5 Residual Risk Financial Considerations
- Step 5 Risk Control Strategies & Measures
- Step 5 Stakeholder Communications

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

STEP SIX - ACTION AND MONITORING

4.1.48 General

This step entails implementing the chosen risk control option(s), evaluating the effectiveness of the risk management decision process, and implementing an ongoing monitoring program.

4.1.49 Purpose

The Action and Monitoring program has four key purposes:

1. To detect and adapt to changing circumstances.
    - This is essentially an environmental scan where the system is observed on a routine basis to identify changes in risks, stakeholders, system components, etc. Things change. New risks may crop up and old risks may disappear. Stakeholders and social concerns change, and new issues arise. It is essential that the operating environment be systematically reviewed on a timely basis so that changes are recognized and factored into program decisions.
2. To ensure that the program is achieving the results expected of it.
    - This means establishing standards of what constitutes acceptable performance, comparing actual performance with established standards, and correcting for substandard performance. Corrections do not necessarily constitute adding more risk control. Sometimes the bar was set unreasonably high in the first place. This can be determined, with improved certainty, only after the risk program has been in place for a time.
3. To ensure proper implementation of communication, control and residual risk strategies.
    - This could include some form of inspection function to verify compliance with CCG policies.
4. To verify correctness of assumptions.
    - Several assumptions are made prior to and during the analyses. These assumptions should be revisited in a timely fashion to verify initial perceptions. Analyses made need to be modified, adjusted or redone if assumptions do not prove out.

4.1.50 Scope

In this step:

- Decisions must be made regarding the implementation of the chosen risk control options;
- The effectiveness of this process must be evaluated to determine whether it provides sufficient information for making informed judgements; and
- An ongoing program for monitoring the risk control options must be developed and implemented.

4.1.51 *Communications and Consultation - Action and Monitoring*

- To engage stakeholders in the development of implementation plan; and
- Communicate with stakeholders and public prior to, during and after implementation.

4.1.52 Action and Monitoring Planning

The key to successfully implementing the chosen risk control strategies is to first develop an implementation plan.

If a risk control measure was decided upon, an implementation plan will be developed. Implementation plans will consider timing, resource availability, technical issues, manpower, training and any other issues that need to be considered in light of the decision. A communications plan will be developed to accompany the implementation plan. This plan would include considerations such as:

- Who will be involved in the implementation?
- What will the timing be? Is timing an issue?
- With whom might there be a need to communicate prior to, and during the implementation?

The monitoring program's function is to:

- Detect and adapt to changing circumstances related to the affected area;
- Ensure that the risk control measures put in place (including policies and programs) are achieving the expected results;
- Ensure that control measures and communications have been implemented properly; and
- Verify the correctness of the assumptions made in the Analysis.

4.1.52.1 Changing Circumstances

There may be changing circumstances within the area under review. For example, this could include changes to the international SAR agreements Canada has with other nations, changes to the SAR policies or programs, changes to vessel traffic, seasonal or climate change. Changes to the environment of the area under review can generate changes to the risks; old risks may disappear, or new risks may arise.

4.1.52.2 Performance Standards Adjustments

Expectations may be defined as performance standards against which actual results are measured. In the case of maritime SAR response, the CCG Performance Standard is the over-arching standard to be achieved. If this standard is not met, adjustments will need to be made. This could mean implementing a new risk control strategy.

4.1.52.3 Risk Control Options Adjustments

Sometimes a deficiency can result from the implementation of the risk control program, and not from the program itself. A check will need to be carried out to ensure that the risk control option

(e.g. policies, procedures or programs) have been implemented properly. This may mean verifying that other stakeholders are meeting obligations accepted by them.

4.1.52.4 Assumption Analysis

During the Analysis, several assumptions were made. They might relate to:

- The likelihood of the event occurring;
- The range of possible consequences associated with the event;
- The effectiveness and cost of mitigation strategies; and,
- The acceptability of risks.

Several assumptions have been made about the effectiveness of the risk control measures put in place. The outcomes need to be monitored to assess whether the implemented strategies are achieving the expected results. If expectations are not being met, adjustments to the program may need to be made.

It is important, whenever possible, to routinely verify the assumptions used in the Analysis. If the assumptions prove correct, this will lend greater credibility to the Analysis and to the accompanying decisions. If they prove not to be valid, there may be a need to redo or adjust the Analysis, possibly leading to different conclusions.

4.1.53 Decision Review

Lastly, a review of the risk management decision process should be undertaken so lessons can be learned for the next time. These reviews are very beneficial for developing expertise in the decision process, and for improving its efficiency and effectiveness in accomplishing its objectives.

A simple, yet effective method for conducting this review is to convene the Analysis Team and ask the questions:

Given what we know now:

- What worked well?
- What did not work well?
- What would we do differently next time?

These reviews are important to ensuring continuous improvement in risk management decision-making. They also provide an excellent library of lessons learned to aid those new to the decision process.

Whether a risk control measure was implemented or not, there is a need to have a monitoring program that both measures the response system and the exposure of activities. The system measures shall be in accordance with the SAR capacity and SAR capability matrix used to assess response measures.

SAR incident data will continue to be collected and entered into the SISAR system.

The activity levels will be monitored; this way, SAR incident data can be related to activity types and incident rates can be established. This will allow rigorous analysis of information at the next planned review.

Table 8 - Action & Monitoring Checklist

Engage stakeholders in the development of implementation plan	Yes - No
Communicate with stakeholders and public – prior to, during and after implementation	Yes - No

4.1.54 Action / Monitoring Documentation Requirements

Documentation for this step should include:

- Implementation plan;
- Project management plan (if any);
- Monitoring plan; and

Results of monitoring program

4.1.55 Action and Monitoring Template(s)

- Stakeholder Communications [TBD]

Note: Templates described above may be found in RAMSARD Volume III – Toolbox.

4.1.56 Conclusion

The risk management strategies that have evolved through the six-step process should be reviewed periodically. A "sunset" date is established as part of the 5-year cycle, to ensure that the RAMSARD program is reviewed on a consistent basis. Extension requires an analysis to justify the continuation of any control options. If no justification can be established, the control option is terminated. "Sunsetting" aids in ensuring that ineffective or unnecessary actions are not continued indefinitely.

After having undergone the extensive decision processes aided by the RAMSARD analysis steps, it is prudent to evaluate the effectiveness of the risk management process in satisfying the objectives of the decision-maker. This facilitates continuous improvement in the decision-process itself, creating efficiencies for future efforts. This review also provides for greater defensibility of decisions made throughout the process.

Annex A Risk Assessment

A.1 GENERAL

The **Risk Assessment function begins as part of the Step 2** – Risk Identification process when data from SISAR and other sources begin to build a picture using the matrix and scales discussed below. It culminates in building the final reports to senior management. The Risk Assessment operation requires several components, that when combined, will assist in providing a complete picture of the SAR area under review. While overall picture may appear quite complex and daunting, it is simply a building process to be followed in providing a clear analysis. The SAR Risk Assessment tools support the analysis of the SAR area(s) under review by providing a standardized statistics-based approach using analysis of known incidents along with available response using current resource capabilities and capacity. The tools used to assess specific SAR areas build on capability / capacity criteria, response models and estimation matrices. The components build toward an understanding of:

- SAR Risk Estimation;
- Resource Capability / Capacity criteria;
- SAR Response Models;
- Resource Relevance Ratings; and
- SAR Coverage.

The following Risk Assessment templates and tools will assist in carrying out a full RAMSARD analysis where management has directed a review of CCG SAR response resources assigned to or serving an area, or where existing SAR response services are unable to meet CCG minimum Performance Standard. In these instances, it will be necessary to proceed with an assessment of risks in the area under review and evaluation of new Risk Control measures (i.e. an alternate SAR response resource mix) to mitigate those risks. It is important to note that use of these tools will not, by itself, produce the solution required to solve the problem; expert analysis will be required to develop one or more alternate SAR response delivery options for recommendation to management. The following templates and tools will facilitate the assembly of necessary data and information for analysis.

A.2 SAR RISK ESTIMATION MATRIX

SAR Risk Estimation Matrix - is used as a template to proceed with the necessary analysis of the area under review. It is used as a general check of the risk levels found in the area under assessment. The SAR Risk Estimation Matrix is normally completed as a component of Step Three – Risk Estimation (See pages 37 – 39).

National SAR Estimation Matrix - will normally be completed by National Headquarters and updated annually. Once the update is complete, it will be shared with the regional offices.

The matrix is constructed using a standard risk format, as *per National Strategies - Risk Profiling: Risk Assessment Place-mat* that places the **Impact** (Table 9) of the incident on the vertical axis and the **Likelihood** (Table 10) on the horizontal axis. The likelihood and impact scales in the Risk

Assessment Place-mat, which are used to assess corporate crises, were modified to reflect the specifics of SAR.

> *"Percentage of lives saved vs. lives at-risk represents an operational benchmark for the SAR system as a whole. The objective is to save 100% of lives at risk in the marine environment. CCG consistently achieves greater than 90%. Other factors influence the results achieved. Maritime SAR is a systems response involving multiple partners and the result depends greatly on partners (DND, and the CCGA) for response capability. In addition, extenuating, or external factors such as geographical location, weather, and sea state can also impact the results achieved. Note that 'lives saved' figures are derived from M1 and M2 incidents only since lives are not considered at risk in M3 or M4 incident classifications."*

Impact in the context of SAR is limited to lives at risk, as other impacts are not directly associated to the primary mandate of the SAR system and are more difficult to quantify. While additional benefits result from the actions taken to save lives (including reductions in loss of property and environmental damages), these benefits are not part of the national SAR objective and can create confusion regarding the primary mandate of the SAR system. The Impact Table is found below (Pg. A-2, Table 9)

Formula for Impact: Most frequent (Statistical term = MODE) POB # in the incidents

The formula for estimating lives at risk is based on the statistical **mode** of the number of Persons on Board (POB) the incident vessel in each of the incidents recorded.

> ***Mode** is a statistical term that refers to the most frequently occurring number found in a set of numbers. The mode is found by collecting and organizing data in order to count the frequency of each result. The result with the highest number of occurrences is the mode of the set.*

Table 9 - Impact

Impact	
Extreme	More than 50 lives at risk in incident.
High	More than 10 lives at risk in incident.
Moderate	More than 5 lives at risk in incident.
Low	One to five lives at risk in incident.
Negligible	No lives at risk in incident.

Likelihood is a measure of the frequency or interval at which events can be reasonably expected to occur. The frequency is based on an average number of incidents recorded over the period of (5) years used in the formula divided by the number of years used then divided again by 52 weeks to achieve the average number of incidents experienced per week. Note that this number does not account for the variations of incidents experienced during busy and quiet seasons. The Likelihood Table is found below (Pg. A-3, Table 10)

Formula for Likelihood: *# of incidents divided by # of years*

Table 10 - Likelihood

Likelihood		Range for likelihood number
Almost Certain	1 incident or more per week	52+
Likely	1 or more incident per month	11 to 52
Moderate	1 or more incident per year	1 to 11
Unlikely	1 incident every 10 years	0.1 to 0.9
Rare	1 incident every 25 years or more	0.04 to 0.09

Recorded SAR incidents are to be plotted on the SAR Risk Estimation Matrix. To do so, each incident type is assigned a numerical reference.

The existing SAR statistics will be used as an approximation when categorizing the risk scenarios to be included in the SAR Estimation Matrix. By grouping the incidents by vessel category, some broad assumptions can be made about the number of persons on board and lives at risk. For the purposes of identifying a risk profile for an area, this is the most important factor.

The number of persons on board does not automatically assume that they are all at risk in every event. Data on the number of persons on board and lives at risk should be available from the SISAR system. When this data is available, the number of lives at risk will be used to categorize the events on the risk matrix.

Later in the process, the same incidents will be categorized by type (such as fire, disabled, aground, taking on water, striking/collision, overdue), as this factor will be considered in assessing the capabilities that must be considered when determining appropriate SAR coverage.

Table 11 - Category

#	Category	Final Classification	To be included in Risk Matrix
1	Maritime Commercial	M1	Yes
2	Maritime Commercial	M2	Yes
3	Maritime Commercial	M3	Yes
4	Maritime Fishing	M1	Yes
5	Maritime Fishing	M2	Yes
6	Maritime Fishing	M3	Yes
7	Maritime Pleasure	M1	Yes
8	Maritime Pleasure	M2	Yes

9	Maritime Pleasure	M3	Yes
10	Aeronautical	A1	Yes
11	Aeronautical	A2	Yes
12	Aeronautical	A3	Yes
13	Humanitarian	H1	Yes
14	Humanitarian	H2	Yes
15	Humanitarian	H3	Yes

Although a maritime response was delivered for the humanitarian incidents captured above, it is important to note that humanitarian incidents are specifically mentioned in the IAMSAR Vol 4 - Canadian or CAMSAR Manual as a secondary and complementary SAR tasking with the following caveats: SAR units are to be provided when and where available, if there is no other competent authority and if such tasking will not unduly compromise SAR coverage. This description makes it clear that although responses may be delivered for humanitarian incidents, their associated data is not to be used as criteria for resource planning. Their inclusion in RAMSARD is purely educational and illustrative of the current workload on SAR resources, with the explicit understanding that these incidents will not form part of the risk that needs to be addressed when assessing SAR coverage. This distinction is critical and is not well understood by many stakeholders. Key messages to that effect must be included in communications and consultations plans.

Air incidents that occur over water are the only air statistics that are considered in this risk estimation.

The categories of incidents listed above are placed on the matrix. Incidents with the highest probable impact and frequency are considered to be highest risk and they will appear in the upper right quadrant.

Table 12 – SAR Risk Estimation Matrix

Impact	**Extreme**	[redacted]		[redacted]	[redacted]	[redacted]
	High	[redacted]			[redacted]	[redacted]
	Moderate	[redacted]	[redacted]			[redacted]
	Low	[redacted]	[redacted]	[redacted]		
	Negligible	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		Rare	**Unlikely**	**Moderate**	**Likely**	**Almost Certain**
		Likelihood				

In the initial matrix, humanitarian incidents will be included to give a full appreciation of risks and workloads being experienced. They will then be removed from the grid when assessing the coverage needs. For the purposes of estimating resource requirements at Table(s) 12/13 and 14, the matrix will be modified as follows:

- Remove the humanitarian incidents; and
- Highlight the requirement to have some level of preparedness for rare events.

Note: The RAMSARD process is not a relative risk tool and should not be used to compare area risks to other area risks or to the national risk matrix. Each area has unique risks and may have unique resources to cover those risks. During consultations with stakeholders, the national risk matrix will be shown only to indicate that it is complete and to show that local figures are used in the Analysis (as opposed to the national figures being applied to local area assessments).

A.3 NATIONAL SAR RISK ESTIMATION MATRIX

The National SAR Risk Estimation Matrix is a tool managed by National Headquarters for national policy planning only. None of the figures or placements from the national matrix can be directly transferred to the area under review - only the data specific to the area under review can be used for the RAMSARD analysis.

A.4 AREA SAR RISK ESTIMATION MATRIX

Although it may use the National SAR Risk Estimation Matrix as a template, the Area SAR Risk Estimation Matrix will only consider the specific area information gathered during the Risk Identification stage, including user information and the historical SAR incident data for that specific area. The Area SAR Risk Estimation (Matrix) Table Template (Table 12), the Impact (Table 9), Likelihood (Table 10) and Category (Table 11) scales are found above.

While the impacts may be the same for various incident types, they may vary in other cases. For example, an area where fishing is mainly done by small vessels with a two-person crew might have a different profile than an area where the vessels are larger and have an average crew of twelve.

Probability may vary greatly by area. In the Area Risk Estimation Matrix, SISAR data will only be used for incidents with a likelihood of incidents daily to yearly, which covers the Almost Certain to Moderate likelihood categories.

A.5 NATIONAL INCIDENT RATE – LOW PROBABILITY EVENTS

For the low probability or less likely events, a national incident rate will be developed based on incident data looking back as far as possible in waters of Canadian interest. If the existing data is considered insufficient, areas which are considered to have equivalent risks or global industry-wide risks associated with particular activities can be researched. CGHQ staff will develop incident rates for major and rare M1 and M2 events. For example, it will be determined that there is a probability of a specific type of incident happening once in every 10,000 bulk carrier transits, or once in every 25,000 tanker transits, or one in every 200,000 commercial airline flights.

Using traffic statistics for the various traffic types ships and aircraft in the area under review, the Analysis Team will apply the national incident rates to determine whether the incident type if relevant for the Area Risk Estimation Matrix and if so, with what frequency.

Similar to the National SAR Matrix, any incident type falling in the upper right-hand quadrant of this matrix is of immediate concern. However, it is not very probable that any incident type will fall into the high frequency and high consequence range, as the data has been gathered with a SAR system in place.

Once the incident types are rated and placed in the matrix, including the rare events using the recommended national incident rates, the reviewer should study the matrix to note the rankings of the various types of events. During consultations, the reviewer will give a short explanation regarding the statistics presented in the Area Risk Estimation Matrix and the method used to validate the results of the matrix.

A.6 ADJUSTMENTS TO MATRIX

At this point, the reviewer may adjust the matrix to reflect trends or changes in context that may alter the identified risk profile(s) going forward. **However, adjustments may not be made based on perceptions alone; they must be based on a solid, professional, substantive rationale.** Any such change must be documented as to what was modified and why. In every case, the original matrix information must be part of the records and accompanied by its revised version, with a written explanation for the adjustment(s) made.

Adjustments to the matrix cannot generally be made on environmental conditions. Stakeholders will have to be reminded that the weather, tides, and currents existed when the historical incidents took place and that their impact on incidents outcomes is already reflected in the incidents statistics. Modifying the frequency or impact in the matrix to account for environmental hazards would basically mean that environmental hazards would be considered twice for the same event, which would exaggerate the results.

If stakeholders see that adjustments can be made without necessarily being driven by hard data, they may wish to adjust the matrix based on their perception of the risks. Appropriate documentation will help the Analysis Team explain to stakeholders why changes were made. When the stakeholders perceive that the risk estimation is a data-driven exercise, they are more likely to accept the results.

Changes to the area risk matrix may not be made during a consultation session. If new information is offered by the stakeholders, the Analysis Team should accept it for review. After review, a determination can be made to alter the Area Risk Estimation Matrix following the guidance on justification and documentation above.

This approach does allow for information exchange during the consultation, which may lead to further review by the assessor. However, it ensures that a group of stakeholders, no matter how well intentioned, cannot secure a substantive change to the Area Risk Estimation Matrix based on risk perceptions, recent events or other considerations that may not be entirely related to risk.

A.7 METHODOLOGY, UNCERTAINTY AND LIMITATIONS OF DATA DESCRIPTION

The reviewer must create a text to accompany the matrix. At a minimum, it will include information on:

- The methodology used to develop the risk matrix;
- Any uncertainties associated with the data supporting the matrix; and,
- The limitations in the current display of information in the matrix

A speaking point would also remind stakeholders that the statistics shown in the Area Risk Estimation Matrix account for the current SAR resources in place. The existing resources did contribute to reducing the consequences of incidents, or managed incidents at the M4 or M3 stage and prevented their escalation to an M1 or M2 stage. Using this data is still the best approximation available for identifying the risks associated with marine activities in the area.

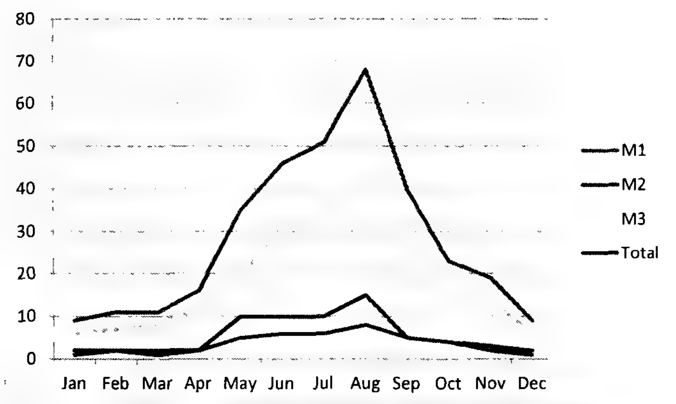
A.8 OTHER TOOLS

Other tools that may be used during the analysis and the consultations are a table and a graph showing the average incidents per month. The incident data used for populating the Area Risk Estimation Matrix are plotted by average number of incidents per month in both the table and the graph (see below for example). This will help the Analysis Team determine whether there is a high season and low season, and whether shoulder seasons need to be considered.

Table 13 - Average Incidents / Month based on 2001-20011 data (sample data)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M1	1	2	1	2	5	6	6	8	5	4	2	1
M2	2	2	2	2	10	10	10	15	5	4	3	2
M3	6	7	8	12	20	30	35	45	30	15	14	6
Total	**9**	**11**	**11**	**16**	**35**	**46**	**51**	**68**	**40**	**23**	**19**	**9**

Table 14 - Average Incidents / Month Chart (sample data)



During consultations, stakeholders will be reminded that numbers of incidents alone cannot be used to determine capability and capacity required, as often in seasons where the incident load is lower, the conditions are harsher, and incidents may take longer to resolve.

A.9 AREA SAR CAPACITY MATRIX

Capacity Description - SAR capacity is described as the availability and response posture of potential responders and resources in a specific area where SAR response can be provided. This matrix is completed for the SAR area only and includes all the potential resources within that area.

Although some of the potential responders will not be resident in the area under review (e.g. RCAF air resources), such resources are still to be included in the capacity matrix. Should the distance between the home of the resource and the area under review require commentary as to response time or endurance, it will be considered in the Capability Relevance section.

Seasonal Adjustments - In the risk estimation Step, all of the incidents are broken out by month to determine whether the area under review has seasonal variations that need consideration (see section above). If significant seasonal variations are noticed, the SAR capacity will be reviewed according to these variations. For example, this recognizes the current practice of increasing SAR coverage for areas of high recreational traffic during the summer months.

The capacity matrix below provides an estimation of resource availability by season. These estimations are based upon the best available information, including SAR incident data for the area that illustrates resource utilization and participation, CCG vessel activity information, published service standards, mariner profiles for the area, interviews with JRCC personnel and consultations with SAR partners and stakeholders.

Season Limits:

- Shoulder (Spring/Fall) - April/May and October/November
- Summer - June to September
- Winter - December to March

For the purposes of consistency, the RAMSARD process will use the same definitions of SAR response resources as the SAR Tasking Policy. This includes four categories of mobile facilities available for SAR response. The first three categories are considered SAR units, ranging from Primary vessels to CCGA, and the fourth category is made up of civilians, including vessels of opportunity:

- **Search and Rescue Unit - Primary** - A federal SAR aircraft or vessel established and equipped specifically for SAR, with SAR trained crew onboard.
- **Search and Rescue Unit - Secondary** - All units of the federal government that are not primary SAR units, but which may be tasked to aid in the resolution of a SAR incident.
- **Search and Rescue Unit - Other** - Units other than primary or secondary SAR units, which participate in SAR activities when required. This includes non-federal government units, civilian agencies, volunteers, and partially-funded organizations such as the CCGA.
- **Civilian volunteers** - Vessels of opportunity or other civilian facilities that can be directed under the Canada Shipping Act, 2001 or requested to assist with a SAR operation.

Table 15 - Capacity Matrix - Availability & Response Posture of Potential Responders (sample data)

Resource	Shoulder	Summer	Winter	Notes
		Primary		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]				
		Secondary		
[illegible]				

Resource	Shoulder	Summer	Winter	Notes
		Other		
[illegible]				[illegible]
[illegible]				
		Civilian		
[illegible]				[illegible]
[illegible]				[illegible]

The capacity matrix above is not all inclusive. The reviewer will be responsible for completing this matrix fully for the area under review and validating it with stakeholders.

A.10 SAR Capability Rating Criteria

Capability Description - SAR capability is described as the ability of resources to provide response to SAR incidents. Where possible, the SAR Capability Rating is linked to a standard (e.g. SAR Service Standard, CCG Statements of Operational Requirements, CGFO 207 SAR Equipment, and IAMSAR Volume III - Mobile Facilities). Where such a standard does not exist, the criteria have been established by SAR experts and will be validated on an ongoing basis.

The combination of resource, equipment and crew capabilities are assessed to arrive at a SAR capability rating. The capability rating is not a pass or fail, and there is a subjective component to the rating. Its objective is to lay out in a common format the factors considered when assessing SAR coverage or the design of a vessel for SAR operations.

The following twelve SAR capabilities and their associated rating criteria are to be used as a reference:

A. Speed
B. Endurance / Range
C. Sea keeping
D. Search
E. Survivor Recovery/Care/Transportation
F. First Aid / Medical

G. On Scene Coordination
H. Towing
I. Fire Protective Equipment
J. Dewatering
K. Redundancy
L. Survival Support

A-K are Marine SAR Capabilities

A.B.D, E, F, G, L are Air SAR Capabilities

The following SAR Rating tables include references to standards (where they exist) as well as a brief explanation for each rating criteria.

A.11 NATIONAL AIR AND MARINE SAR CAPABILITY MATRICES

As many regions and areas use similar resources, National Air and Marine SAR Capability Matrices are used to rate all types of SAR resources (various CCG, CAF and CCGA vessels; local resources; vessels of opportunity; aircraft; etc.). This extensive listing will be subject to validation from SAR program specialists, CCG Operations staff, SAR partners, operational personnel, and stakeholders.

The National Air and Marine SAR Capability Matrices help to ensure consistency of ratings between regions and areas and makes for easier determination of SAR capabilities by the Analysis Team.

> ***Note:*** *air resources must be considered when designing marine SAR coverage and rating the capability of these resources will ensure that no undue reliance is placed on less capable resources.*

National Marine SAR Capability – Rating Criteria - The Assessment Scales for the Marine Resource Capability Rating presented in the National Marine SAR Capability Matrix are found in the tables below. Further information and details may be found at Annex B. Note that the National Marine SAR Capability Matrix information is held at the CCG National HQ and is updated annually. Some new CCG vessels and commercial operators may not be immediately available.

Table 16 - SAR Capability A - Speed (Sp)

Rating	Criteria
7	Vessel able to make 40 knots or greater.
6	Vessel able to make 35 knots or greater.
5	Vessel able to make 30 knots or greater.
4	Vessel able to make 25 knots in fair conditions, or major vessel able to launch independent Fast Rescue Craft (FRC) that can make 25 knots.
3	Vessel able to make 20 knots.
2	Vessel able to make 15 knots.

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1	Vessel able to make 10 knots or less.
Standards / application of criteria	There is no defined speed requirement standard, but speed is rated as it affects time to reach an incident and how quickly a resource can be dispatched to return the SAR unit for readiness posture.

Table 17 - SAR Capability B - Endurance / Range (End)

Rating	Criteria
7	Vessel range of at least 800 NM and greater than 40 hours of continuous operation.
6	Vessel range of at least 600 NM and 30 hours of continuous operation.
5	Vessel range of at least 400 NM and 20 hours of continuous operation.
4	Vessel range of at least 200 NM and 10 hours of continuous operation.
3	Vessel range of less than 200 NM and 10 hours of continuous operation.
2	Vessel range of less than 100 NM and 5 hours of continuous operation.
1	Vessel range of less than 50 NM and 3 hours of continuous operation.
Standards / application of criteria	Although these criteria are more useful for offshore areas and extended incidents, all assets will be rated.

Table 18 - SAR Capability C - Sea Keeping (SK)

Rating	Criteria
7	Vessel able to operate effectively in storm conditions (winds of 50-55 knots) and sea state 10 (9-12.5 metres in open sea).
6	Vessel able to operate effectively in a strong gale (winds of 45 knots) and sea state 9 (7-10 metres in open sea).
5	Vessel able to operate effectively in a gale (winds of 35-40 knots) and sea state 8 (5.5-7.5 metres in open sea)
4	Vessel able to operate effectively in a near gale (winds of 30 knots) and sea state 7 (4-5.5 metres in open sea).
3	Vessel able to operate effectively in a strong breeze (winds of 25 knots) and sea state 6 (3-4 metres in open sea).
2	Vessel able to operate effectively in a fresh breeze (winds of 20 knots) and sea state 5 (2-2.5 metres in open sea).
1	Vessel able to operate effectively in a moderate breeze (winds of 15 knots) and sea state 4 (1-1.5 metres in open sea).
Standards / application of criteria	Existing requirement to operate in the prevailing environmental conditions: Beaufort Scale (http://www.tc.gc.ca/eng/marinesafety/tp-tp10038-80-wi-beaufort-scale-324.htm).

Table 19 - SAR Capability D - Search (S)

Rating	Criteria
7	Vessel has all equipment noted below; at least 20 feet height of eye; and sufficient crew to conduct visual and electronic searches simultaneously.
6	Vessel has all equipment noted below and Forward Looking Infrared (FLIR).
5	Vessel has baseline equipment plus Self Locating DMB (SLDMB).
4	Vessel has the following equipment and attributes: • electronic navigation equipment sufficient to conduct extended search in restricted visibility; • enclosed bridge with at least 8 feet height of eye; • Data Marker Buoy (DMB); • Direction Finder (DF); • binoculars; • search light with minimum candle power; and • night vision equipment.
3	Vessel has electronic navigation equipment, but does not carry one of the following: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; or • night vision equipment.
2	Vessel has electronic navigation equipment, but does not carry two of the following: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; or • night vision equipment.
1	Vessel does not have electronic navigation equipment or does not carry: • enclosed bridge with at least 8 feet height of eye; • DMB; • DF; • binoculars; • search light with minimum candle power; nor • night vision equipment.
Standards / application of criteria	SAR

Table 20 - SAR Capability E - Survivor Recovery, Care & Transportation (Rec)

Rating	Criteria
7	Vessel can carry more than 50 survivors in a sheltered location.
6	Vessel can carry more than 25 survivors in a sheltered location.
5	Vessel can carry more than 12 survivors in a sheltered location.
4	Vessel can carry less than 12 survivors in a sheltered location.
3	Vessel can carry less than 12 survivors in an exposed location.
2	Vessel can carry less than five survivors in a sheltered location.
1	Vessel can carry less than five survivors in exposed location.
Standards / application of criteria	Safety of Life at Sea SAR Convention - retrieve persons in distress, provide for their medical or other needs and deliver them to a place of safety.

Table 21 - SAR Capability F - First Aid / Medical Training, Space & Equipment (FA)

Rating	Criteria
7	Doctor of Emergency Medicine or equivalent.
6	Advanced Care Paramedic (ACP) or equivalent (e.g. Physician's Assistant).
5	Primary Care Paramedic (PCP) or equivalent (e.g. CAF SAR Technician).
4	CCG Rescue Specialist or equivalent (e.g. Emergency Medical Responder [3-week training course]) with SAR first aid equipment as per CGFO 207 or equivalent, and sheltered space for at least one stretcher patient.
3	Advanced first aid training (e.g. Marine Advanced First Aid, Medical First Responder, Advanced Wilderness First Aid, OFA 3 [1- or 2-week course]) or no shelter for at least one stretcher patient.
2	Standard first aid training (e.g. Marine Basic First Aid, Standard First Aid [2-day course]).
1	No first aid training (vessel may have First Aid trained person on board, but there is no requirement that this be carried).
Standards / application of criteria	CCG's SAR Levels of Service / Service Standards require that "all SAR units carry a trained Rescue Specialist capable of providing pre-hospital medical care".

Table 22 - SAR Capability G - On-Scene Coordination (OSC)

Rating	Criteria
7	Vessel has capability to co-ordinate air search in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF - FM radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
6	In addition to the attributes below Vessel has sufficient crew to conduct simultaneous visual and electronic searches in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF - FM radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
5	Vessel has sufficient crew to have a full navigational watch and an On-Scene Coordinator in addition to the following attributes: • sufficient communications equipment (minimum 2 VHF - FM radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
4	Vessel has the following attributes: • sufficient communications equipment (minimum 2 VHF - FM radio sets); • an enclosed bridge with space sufficient to lay out marine chart; and • personnel trained as On-Scene Coordinator.
3	Vessel is missing one of the attributes from rating level 4 criteria
2	Vessel is missing two of the attributes: from rating level 4 criteria
1	Vessel is missing three of the attributes: from rating level 4 criteria
Standards / application of criteria	For longer and more complex cases, the On-Scene Coordination attribute is a fundamental resource provided by CCG.

Table 23 - SAR Capability H - Towing (Tow)

Rating	Criteria
7	Vessel is fitted for towing large displacement hull vessels and has a bollard pull of greater than 50 tonnes
6	Vessel is fitted for towing large displacement hull vessels and has a bollard pull of 20 to 50 tonnes
5	Vessel is fitted for towing displacement hull vessels greater than 36 feet and has a bollard pull of less than 20 tonnes
4	Vessel is fitted for towing a displacement hull vessel of at least 36 feet in 30 knot winds
3	Vessel is fitted for towing a displacement hull vessel of at least 30 feet in 20 knot winds
2	Vessel is fitted for towing a planning hull vessel of at least 24 feet in 20 knot winds
1	Vessel is not fitted for towing (no tow post or tow line)
Standards / application of criteria	Although towing may be a service of last resort, it can be a useful and practical SAR response strategy.

Table 24 - SAR Capability I - Fire Protective Equipment (FPE)

Rating	Criteria
6	Vessel has: • capability to refill self-contained breathing apparatus (SCBA) bottles on board; • spare SCBAs and bottles that can be transferred to casualty; • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
5	Vessel has: • spare SCBAs and bottles that can be transferred to casualty; • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
4	Vessel has: • external fire monitor(s) to provide protective spray to allow safe approach; • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
3	Vessel has: • capacity to rig fire hoses to provide protective spray to allow safe approach; • additional extinguisher(s) that can be transferred to casualty
2	Vessel has additional extinguisher(s) that can be transferred to casualty
1	Vessel carries no additional fire protective equipment
Standards / application of criteria	In line with Fleet Safety Manual 7.D.1 Search and Rescue Operations.

Table 25 - SAR Capability J - Dewatering (DeW)

Rating	Criteria
4	Vessel has a high-capacity submersible pump that can be deployed to another vessel
3	Vessel has two dewatering pumps, including one that can be deployed to another vessel

2	Vessel has a dewatering pump (minimum 3.5 hp) that can be deployed to another vessel
1	Vessel has no portable dewatering capability
Standards / application of criteria	In line with CGFO 207 - SAR Equipment

Table 26 - SAR Capability K - Redundancy / Robustness (R/R)

Rating	Criteria
7	Vessel: • Has double hull; • stability condition for deck icing; • has three independent means of position fixing; or two compasses or VHF DF; and • Is twin screw and has backup steering system
6	Vessel: • stability condition for deck icing; • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
5	Vessel: • has double hull; • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
4	Vessel: • has three independent means of position fixing; or two compasses; or VHF DF; and • is twin screw and has backup steering system.
3	Vessel is twin screw and has backup steering system.
2	Vessel is twin screw.
1	Vessel has no redundancy of systems.
Standards / application of criteria	Statement of Operational Requirements for Offshore SAR ships, Motor Lifeboats, and Inshore Rescue Boats.

A.12 MARINE SAR CAPABILITY MATRIX

Table 27 - Marine Resources SAR Capability Ratings* ([illegible])

Resource	SAR Capability												
	A - Speed	B – End	C - SK	D - S	E - Rec	F - FA	G - OSC	H - Tow	I - FPE	J - DeW	K - R/R	L - S/S	Total Ratings*
[illegible]													[illegible]
[illegible]													52
[illegible]													[illegible]
[illegible]													[illegible]

Ratings are to be applied to each resource available in the area under review.

*** The rating number is only used for rough comparative purposes. The criteria themselves have not been prioritized against each other - they are all considered equally important.*

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A.13 AIR SAR CAPABILITY RATING CRITERIA

Table 28 - Air SAR Capability A - Speed (Sp)

Rating	Criteria
6	Craft cruising speed 200-300 knots and capable of slowing if required for optimal searching
5	Craft cruising speed 200-300 knots
4	Craft cruising speed 150-200 knots
3	Craft cruising speed 100-150 knots
2	Craft cruising speed < 100 knots
1	Craft normal operating speeds exceed 300 knots
Standards / application of criteria	There is no defined speed requirement standard, but speed is rated as it affects time to reach an incident and how quickly a resource can be dispatched to return the SAR unit for readiness posture. For SAR using an aircraft, speed can become an issue, as searching at too much speed is not practical.

Table 29 - Air SAR Capability B - Endurance / Range (End)

Rating	Criteria
7	Range of +700 NM
6	Range of 600- 700 NM
5	Range of 500- 600 NM
4	Range of 400-500 NM
3	Range of 300- 400 NM
2	Range of 200- 300 NM
1	Range of less than 200 NM
Standards / application of criteria	

Table 30 - Air SAR Capability D - Search (S)

Rating	Criteria
7	Craft: has enhanced electronic searching technologies and SLDMB is IFR, has air and marine radio frequencies and DF has dedicated observation locations for spotters
6	Craft: has enhanced electronic searching technologies and SLDMB is IFR, has air and marine radio frequencies and DF
5	Craft is IFR, has air and marine radio frequencies and DF

4	Craft is IFR and has air and marine radio frequencies
3	Craft is IFR
2	Craft is VFR with air and marine radio frequencies
1	Craft is VFR with no additional tools for searching
Standards / application of criteria	SAR

Table 31 - Air SAR Capability E - Survivor Recovery & Transport (Rec)

Rating	Criteria
6	Craft can winch up casualties and take more than 20 survivors
5	Craft can winch up casualties and take up to 20 survivors
4	Craft can winch up casualties and take up to 12 survivors
3	Craft can winch up casualties and take up to 5 survivors
2	Craft can land on incident site and take more than 5 survivors
1	Craft can land on incident site and take up to 5 survivors
Standards / application of criteria	SAR Convention - retrieve persons in distress, provide for their medical or other needs and deliver them to a place of safety

Table 32 - Air SAR Capability F - First Aid / Medical Training, Space & Equipment (FA)

Rating	Criteria
7	Doctor of Emergency Medicine or equivalent
6	Advanced Care Paramedic (ACP) or equivalent (e.g. Physician's Assistant)
5	Primary Care Paramedic (PCP) or equivalent (e.g. CAF SAR Technician)
4	CCG Rescue Specialist or equivalent (e.g. Emergency Medical Responder [3-week training course]) with SAR first aid equipment as per CGFO 207 or equivalent
3	Advanced first aid training (e.g. Marine Advanced First Aid, Medical First Responder, Advanced Wilderness First Aid, OFA 3 [1- or 2-week course]) or shelter for at least one stretcher patient
2	Standard first aid training (e.g. Marine Basic First Aid, Standard First Aid [2-day course])
1	No first aid training (vessel may have First Aid trained person on board, but there is no requirement that this be carried)

Standards / application of criteria	

Table 33 - Air SAR Capability G - On-Scene Coordination (OSC)

Rating	Criteria
4	Craft has trained On-Scene Coordinator and sufficient crew to allow On-Scene Coordinator to focus on On-Scene Coordination role
3	Craft has trained On-Scene Coordinator
2	Craft has enhanced communications capabilities (air and marine) but no trained On-Scene Coordinator
1	Craft has no special On-Scene Co-ordination capabilities
Standards / application of criteria	

Table 34 - Air SAR Capability L - Survival Support (S/S)

Rating	Criteria
4	Craft can deploy life rafts
3	Craft can deploy water and rations
2	Craft can deploy dewatering pump
1	Craft has no survival support equipment
Standards / application of criteria	

Table 35 - Air SAR Capability Matrix ([illegible])

Resource	Air SAR Capability Ratings*												
	A - Speed	B - End	C - SK	D - S	E - Rec	F - FA	G - OSC	H - Tow	I - FPE	J - DeW	K - R/R	L - S/S	Total Ratings*
[illegible]													
[illegible]													

** Ratings are to be applied to each resource available in the area under review.*

*** The rating number is only used for rough comparative purposes. The criteria themselves have not been prioritized against each other - they are all considered equally important*

A.14 AREA SAR CAPABILITY MATRIX

The Area SAR Capability Matrix is an overview of all marine and air SAR resources available in the area under review and is prepared based on the ratings identified in the National Air and Marine Capability Matrix.

The Analysis Team needs to gather information about and describe the resources prior to applying the rating criteria. Using the National Air and Marine SAR Capability Matrices, they are to prepare the following two tables:

- **Table 36** is the Area SAR Resource Description, where the Analysis Team provides a description of the attributes of the vessel/aircraft, equipment and crew that are relevant to SAR capability. This description is based on facts and will form the basis of **Table 2**. This resource description table will primarily be used for informing stakeholders on the various potential responders.
- **Table 37** is the Area SAR Capability Matrix, where the Analysis Team applies the rating criteria for the selected SAR capabilities to the air and marine resources available in the area under review.

Note: The information on air resources is relevant to the process in order to apprise stakeholders of the full breadth and scope of the potential response resources available in the area under review and to inform stakeholders of the necessary layers of a successful SAR system.

Table 36 - Area (add area #) SAR Resource Description (   )

Resources - Area X	Description

Table 37 - Area (add area #) SAR Capability Matrix ([illegible])

Resource	Area X SAR Capability Matrix												
	A - Speed	B - End	C - SK	D - S	E - Rec	F - FA	G - OSC	H - Tow	I - FPE	J - DeW	K - R/R	L - S/S	Total Ratings**
CCG ZH 753 Fast Rescue Craft (includes IRB)	7	2	5	2	1	3	2	2	1	2	2		**29**
CCG 47' Motor Lifeboat	4	4	5	4	4	4	4	4	4	2	4		**43**
CCG Mid-Shore Patrol	2	7	6	5	6	4	5	5	4	2	6		**52**
AIR													

**Ratings are to be applied to each resource available in the area under review.*

*** The rating number is only used for rough comparative purposes. The criteria themselves have not been prioritized against each other - they are all considered equally important*

A.15 SAR RESPONSE MODEL

Coverage Model Description - The coverage model is based on search and rescue response.

When examining the response at the operational level, the policy underpinnings must be in place. Policy defines the role that CCG SAR Units have in the Canadian SAR system. Although many expect that the CCG is the first, mid-level and last resource for SAR incidents all at once, this is not the case. Over the past twenty years, the shift has been steadily further away from a CCG total response model.

The move to station-based lifeboats began in the 1990s as the large ship fleet was rationalized. This saw the last of the offshore SAR ships retired and replaced by an increased and renewed lifeboat fleet and maintenance of offshore SAR zone coverage where required by multi-tasked vessels.

Now, in Canada, SAR services are provided by the following four categories of resources:

- **Category 1** - Primary SAR resources (lifeboats, inshore rescue boats, CCG ships assigned to SAR coverage)
- **Category 2** - Secondary federal government resources (CCG vessels not assigned to SAR duties, CAF vessels, RCMP, Parks Canada)
- **Category 3** - Other responders (non-federal government, CCGA, civilian agencies)
- **Category 4** - Civilian responders (commercial or recreational vessels of opportunity)

Response to M1 Incidents- Distress - In the case of M1 incidents, which are actual distress incidents, CCG SAR Units may not be the first responder on scene. When a distress is declared, proximity and speed of resources are more important than the total capability they provide. In these cases, CCG resources fulfill several functions including; primary responder, on-scene coordinator and rescue platform.

For this type of incident, it will be helpful to look at a risk scenario. A good example of risk scenario in this case is a large ferry on fire or sinking. Given the large numbers, geographical distribution and the low incident rate, it would not be appropriate to have a fully capable resource within the vicinity of every ferry in Canada. Rather, this risk may be covered as follows:

- A CCG lifeboat can provide on-scene communications and coordination for the first 12 to 36 hours, until it can hand off this responsibility to a more capable resource if the distress step is not resolved before more capable government resources arrive;
- This approach allows for others, such as vessels of opportunity, to respond while the on-scene coordination and communications are being professionally managed by the CCG lifeboat;
- If a more capable government resource is available, the lifeboat becomes a responder of special capability that can be utilized by the on-scene co-ordinator as needed; and
- CAF air resources are available to assist with on-scene communications and coordination in cases where the workload needs to be shared due to volume or where the CCG resource is unable to respond.

Coverage for more frequent M1 events, particularly those involving pleasure craft or fishing vessels, may be provided solely by CCG SAR Units. In areas where the risk profile indicates a need for SAR coverage, it is beneficial to have a resource positioned that enables a primary response. This resource may be a lifeboat station or an inshore rescue boat station, depending on the level and timing of the risks. While much of the work for SAR vessels involves M3 incidents SAR vessels are still considered primary responders within their area of operation for all categories of incidents.

Response to M2 Incidents – Potential Distress - M2 incidents are potential distress incidents. Typically, when coverage is assessed and in place for both the M3 and M1 categories, there is no need for supplementary coverage for M2 incidents. If the risk profile indicates a high rate of M2 incidents with unacceptable outcomes, this assumption may be revisited.

Because of both the capability and location of CCG SAR Units, they are often able to intervene at the M2 level. At the M2 level, the JRCC may request commercial ships to respond, but may not compel them to do so. The M2 incidents are more likely to have major government vessels diverted from other tasks and support from CCGA to augment the CCG response. The nature of the incident will determine the magnitude of the response. At the M2 level, the SAR Mission Co-ordinator may use their discretion to elevate the case to an M1.

Response to M3 Incidents – Assistance to disabled vessels (Non-distress) - The preceding description of where the CCG SAR Units are as assets is an important precursor to understanding the professional, scalable response that is available for SAR incidents in all categories.

Risks associated with M3 incidents are well understood, and the RAMSARD methodology uses historic incident data as approximations for risk scenarios. In these scenarios, there are a range of acceptable SAR Units that can safely provide a response depending on the circumstances, including the area of operation, the type and size of vessel requiring assistance, and the nature of difficulty. The range of potentially suitable responders includes recreational craft, fishing vessels, fast rescue craft, lifeboats, patrol craft, and major government vessels.

CCG provides most of the response to M3 incidents in areas of high traffic volume. Typical incidents in this category are a disabled vessel that need a tow, fuel or mechanical assistance; loss of situational awareness requiring locating and redirecting; a vessel aground with no danger to crew that must wait for high tide or commercial towing assistance. When no commercial assistance alternative is available, these calls fall to the CCG for response, as there are no legal grounds or desire to divert commercial ships for non-distress incidents.

Even with CCG providing SAR Units to resolve M3 incidents, there are many cases where another resource is on scene and provides the service first. Such instances can often be handled either by CCGA or other government resources who suffer little or no imposition by responding to such events. In some cases, private vessels in the area assist vessels requiring support without being compelled to do so.

Most of the M3 incidents happen near shore, and the associated risk should be covered adequately by relatively small vessels. There are exceptions related primarily to disabled vessels in offshore areas.

Response to M4 Incidents – False Alarms or Hoaxes - M4 incidents are classified as false alarms or hoaxes after the closure of the incident. However, until it is determined that they are a false alarm, they are usually treated as M1 and M2 incidents, with a corresponding level of response.

A.16 SAR COVERAGE DETERMINATION

The following definitions specified in the *2007 SAR Needs Analysis*:

- **SAR system coverage capability**: the ability of vessels/crews to provide response to SAR cases, as evaluated by vessel features such as size, speed, manoeuvrability, power, equipment on board, etc.;
- **SAR system coverage capacity**: the number of vessels in an area capable of providing SAR response.

These definitions only speak to the number of vessels capable of responding and the ability to respond based on the characteristics of the vessels. The RAMSARD process looks at capability and capacity but also looks more broadly at SAR coverage. In this instance the definition will be: SAR coverage: the people, equipment (including aircraft) and resources considered available for a response to a search and rescue event.

- **SAR coverage** can be subdivided into two categories, planned and opportunity coverage:
  - **Planned coverage** includes: CCG lifeboats, CCG inshore rescue, multi-tasked CCG ships assigned to offshore zones, RCAF fixed and rotary wing primary SAR aircraft, and oil rig standby vessels (TP7920 Standards Respecting Standby Vessels).
  - **Opportunity coverage** includes but is not limited to: other CCG vessels not on SAR standby, CCG Auxiliary vessels, Royal Canadian Navy vessels, other government vessels and aircraft, as well as all commercial and recreational vessels.

Commented [GN2]: Confirm this is still accurate and applicable.

SAR Breakdown of Incidents by Category, Type & Location - In waters of Canadian interest, the communications and co-ordination of SAR at the system level are all planned coverage. In some M1 cases, there is a need for on-scene co-ordination and communication which is normally provided by a government vessel or aircraft. Given the remoteness of some locations, it may be necessary for non-government resources to provide this service.

The process for assessing SAR response coverage includes looking at the locations where the risks take place, followed by the severity of the incidents that take place and then followed by the types of incidents that take place.

Based on the information collected in the preliminary analysis as well as data provided through systems such as SISAR, the reviewer is to fill out the table below to give an overview of the incidents happening in the area as well as the locations where they happen within a specified time frame.

Table 38 - SAR Breakdown of Incidents by Category, Type & Location (add area #)

Category	Incident Type	Remote	Offshore	In-Shore	Total
M1	Capsized/Founder/Collision				
	Disabled/Grounded/Stranded				
	Fire				
	Man Overboard/PIW/Suicide + Attempt				
	Medical				
	Disoriented/Missing Person(s)				
	Taking on Water				
	Other				
	Total (M1)				
M2	Capsized/Founder/Collision				
	Disabled/Grounded/Stranded				
	Fire				
	Man Overboard/PIW/Suicide + Attempt				
	Medical				
	Disoriented/Missing Person(s)				
	Taking on Water				
	Other				
	Total (M2)				
M3	Capsized/Founder/Collision				
	Disabled/Grounded/Stranded				
	Fire				
	Man Overboard/PIW/Suicide + Attempt				
	Medical				
	Disoriented/Missing Person(s)				
	Taking on Water				
	Total (M3)				
All	**Total (all cat.)**				

Inshore:	*0 to 6 Nautical Miles - Based on Inshore Rescue Boats Specs*
Offshore:	*6.1 to 74.9 Nautical Miles - Based on SAR Station Radius.*
Remote:	*75+ Nautical Miles*

A.17 CAPABILITY RELEVANCE

To analyze capability relevance, the reviewer must assess the significance (or relevance) of each air and marine resource capability rating against the SAR response that must be provided to the incidents identified in the Breakdown of Area Incidents by Category, Type and Location (Table 38, above). Further information and details on capabilities may be found at **Annex B**. Note that the National Marine SAR Capability Matrix information is held at the CCG National HQ and is updated annually. Some new CCG vessels and commercial operators may not be immediately available.

Relevance Rating Tables - Relevance ratings are attributed through the creation of the following four tables:

- M1/M2 incidents happening in-shore (*0 to 6 Nautical Miles*);
- M1/M2 incidents happening offshore *(6.1 to 74.9 Nautical Miles*);
- M3 incidents happening in-shore (*0 to 6 Nautical Miles*); and
- M3 incidents happening offshore (*6.1 to 74.9 Nautical Miles*)

Relevance Rating Scale - The relevance rating is based on a scale from one to five, with:

- One (1) – not very relevant; and
- Five (5) - extremely relevant.

The scale assesses the significance (or relevance) of each air and marine resource capability rating against the SAR response that must be provided to the incidents identified in the Breakdown of Area Incidents by Category, Type and Location Table.

Relevance Rating Comments Columns - The comments column provides an opportunity to expand on the relevance or nuances associated with the capability. For example: The searching may be rated as highly relevant (5) and the comments may indicate: the area has many islands and normal operations require high speed searches amongst islands and shorelines. This comment should be reflected in the preferred SAR units for the task.

The relevance rating is never to be used as a tool for deleting or reducing a capability. Capability may be necessary to safeguard the crew or for assuring preparedness

Once the relevance ratings are attributed to each capability criteria, the SAR units identified in the Area X SAR Capability Matrix will be assessed against these ratings. This approach will allow the reviewer to match preferred responders or SAR units to the risks indicated in the risk profile.

Note: Given the overriding role of vessels of opportunity and the role that proximity plays in M1 incidents, the capability relevance should look primarily at providing on-scene coordination and communications. ***To ensure a consistent approach to this nationally, the relevance of OSC and Redundancy/Robustness will be rated at 5 and no other capability may be rated at 5.***

Table 39 - Relevance Rating Table(s)

Capability	Relevance	Comments	Preferred SAR Units
Speed			
Endurance			
Sea-keeping			
Searching			
Rescue/Transport			
First Aid			
On Scene Command			
Towing			
Fire Protection			
Dewatering			
Redundancy/Robustness			
Survival/Support			

A.18 SAR CAPACITY REQUIRED FOR M1/M2 INCIDENTS

The SAR Capacity requirements will be in a narrative format and include:

- A brief area description
- A recap of the seasonal divisions and rational (if applicable)
- Planned primary coverage
- Reliance on secondary, other and civilian coverage.
- The role that air assets Primary, secondary, other and civilian fill in covering the risks in conjunction with marine assets.
- Assessment as to whether the mix of planned and opportunity coverage is adequate given the risk profile for M1 and M2 incidents in the area paying particular regard to the capability and capacity in place for the M3 incidents.

A.19 SAR CAPACITY REQUIRED FOR M3 INCIDENTS

The SAR Capacity requirements will be in a narrative format and include:

- A brief area description
- A recap of the seasonal divisions and rational (if applicable)
- Planned primary coverage
- Reliance on secondary, other and civilian coverage.
- The role that both air and marine assets (primary, secondary, other and civilian) fill in covering the risks in conjunction with each other.

- Assessment as to whether the mix of planned and opportunity coverage is adequate given the risk profile for M3 incidents in the area.

A.20 SAR COVERAGE CHARTS

For each area assessed, the Analysis Team or reviewer will develop the following charts:

- A **Primary Coverage Chart** will be developed for the area that indicates the coverage by Category 1 - Primary SAR resources. The chart will show radius of operation of each of the assets except the offshore patrol vessel which will show an area of operation. If the area has been assigned seasons, a chart will be developed for each season.
- The **Secondary Coverage Chart** will show an indication of the capacity and capability provided by Category 2 - Secondary federal government resources. This will be done for each season.
- The **Tertiary Coverage Chart** will show an indication of the capacity and capability provided by Category 3 - Other responders.
- The **Civilian Coverage Chart** will show the capacity and capability provided by Category 4 - Civilian responders.
- The **Total SAR Coverage Chart** will blend all of the above information on the chart. This chart, although complex, is a representation of what needs to be analyzed when assessing coverage and the implications of lapses or changes to planned SAR coverage. The information is not linear, but multi-faceted; it is managed by a wide range of organizations but provides the complete picture of what must be assessed.

When displaying the information layers, the capability aspect of each layer must be clear. Although large volumes of civilian traffic will show as a large group of potential responders, they are largely the SAR systems clients and they typically bring a low level of capability. When the Total SAR Coverage Chart is first viewed, it will always look like there is an excess of potential responders.

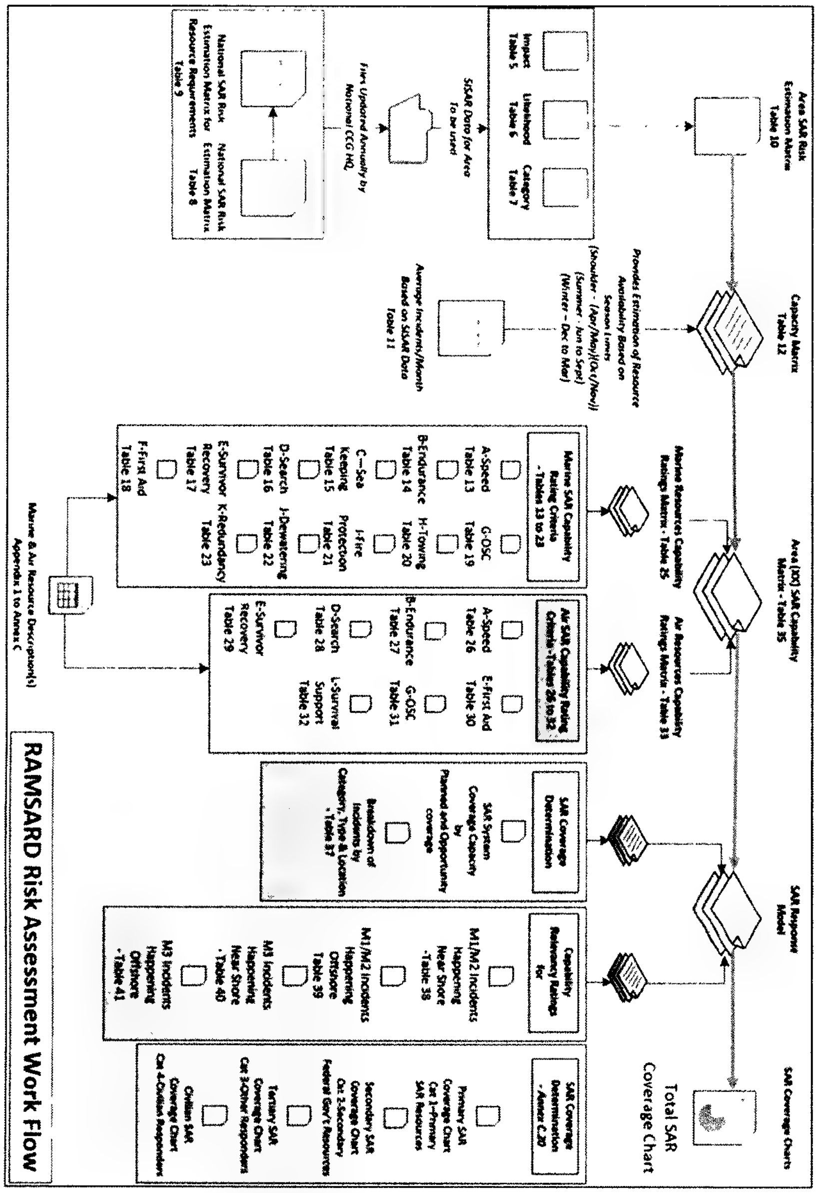
A.21 OBSERVATIONS

The reviewer will make any relevant observations about the coverage, capacity or capability and put them forward as discussion items during consultations. Once the information will be consulted upon, the reviewer will inventory and make note of the observations and comments received and formulate recommendations to the review committee for consideration where deemed appropriate.

A.22 MARITIME SERVICE RISK ASSESSMENT WORKFLOW

The RAMSARD Risk Assessment Workflow Map (Table 39) is intended to provide a visualization of the documentation (Matrices and Scales) used in the RAMSARD process.

Figure 39 – Risk Assessment Workflow Map



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Annex B Glossary of Terms

English	French	Definition
Aeronautical incident	**Incident aéronautique**	A search and rescue incident involving an aircraft
Benchmark	**Point de référence**	A measurable guideline of what can be expected (e.g. timeliness, accuracy, access).
CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines	**ISO 31000 - Formation De Sensibilisation - Gestion Des Risques**	Has superseded (CSA) standard Q850-97, Risk Management: Guidelines for Decision-Makers.
Capacity	**Capacité**	The availability and response time of vessels in an area capable of providing search and rescue response.
Capability	**Aptitude**	The ability of vessels, aircraft and crews to provide response to search and rescue cases, as evaluated by aircraft/vessel characteristics (size, speed, sea keeping, etc.), equipment carried, and crew training and qualifications.
Civil Air Search and Rescue Association (CASARA)	**Association civile de recherche et sauvetage aériens (ACRSA)**	A volunteer organization which provides aeronautical search and rescue support.
Canadian Coast Guard Auxiliary (CCGA)	**Garde côtière auxiliaire canadienne (GCAC)**	A volunteer organization which assists the Canadian Coast Guard in search and rescue response and prevention activities.
Consultation	**Consultation**	The seeking and giving of advice, information, and/or opinion, usually involving a consideration.
CSA Q850	**Norme CSA Q850**	Risk Management: Guideline for Decision-Makers. The Canadian Standard Association's risk management standard. This national standard of Canada provides an effective, credible, and internationally recognized framework for decision-making about the broadest range of risk decisions.
Decision-Maker	**Décideur**	A person or group with the power or authority to make decisions.
Dialogue	**Dialogue**	A process for two-way communication that fosters understanding. It is supported by exchange of information.

English	French	Definition
Distress	**Détresse**	A search and rescue incident where there is a reasonable certainty that one or more individuals are threatened by grave and imminent danger and require immediate assistance.
Fast Rescue Craft (FRC)	**Embarcation rapide de sauvetage (ERS)**	A rigid-hull inflatable with a V-shaped, fiberglass hull and inflatable sponson around the perimeter.
Hazard	**Danger**	A source of potential harm, or a situation with a potential for causing harm, in terms of human injury, damage to health, property, the environment, and other things of value, or some combination of these.
Humanitarian Incident	**Incidents d'ordre humanitaire**	A search and rescue incident (not aeronautical or maritime) which requires a response by the search and rescue system to preserve human life or relieve suffering.
Inter-departmental Committee on Search and Rescue (ICSAR)	**Comité interministériel de recherche et sauvetage (CIRS)**	Consists of senior officials representing federal departments and agencies involved in the National Search and Rescue program. The committee is responsible for advising the Lead Minister of Search and Rescue and the government on issues related to search and rescue in Canada. ICSAR exists to provide interdepartmental co-ordination and advice to the Ministers in the Areas of search and rescue policy, planning, resources, and effectiveness.
Incident rate	**Taux d'incidents**	The number of incidents relative to the amount of traffic.
Initiation	**Lancement**	Consists of defining and structuring the organization's objectives; defining the opportunity or problem triggering the need for risk management decisions; identifying associated risk issues; setting up the risk management team; and beginning the identification of affected stakeholders.
International Maritime Organization (IMO)	**Organisation maritime internationale (IMO)**	The United Nations' specialized agency responsible for safety and security of shipping and for the prevention of marine pollution by ships.
Inshore Rescue Boat (IRB)	**Embarcation de sauvetage côtier (ESC)**	A seasonal Canadian Coast Guard program in which university students (in some regions with Canadian Coast Guard coxswains) operate a fast rescue craft and provide response to search and rescue incidents during the high season.

English	French	Definition
Joint Rescue Coordination Centre (JRCC)	**Centre conjoint de coordination des opérations de sauvetage (JRCC)**	One of three centres in Canada (in Halifax, Trenton, and Victoria), jointly staffed by Canadian Forces and Canadian Coast Guard personnel responsible for planning, co-ordinating, controlling and conducting aeronautical and maritime search and rescue operations within their Search and Rescue Region.
Level of Service (LOS)	**Niveau de service (NS)**	Standards designed to provide Canadian Coast Guard clients with a clear understanding of the services to be expected.
Lives at Risk	**Vies en danger**	The sum of lives assisted, saved, lost, missing as a result of distress and potential distress incidents.
Lives Lost	**Vies perdues**	Lives lost during a search and rescue incident (maritime, aeronautical or humanitarian).
Lives Saved	**Vies sauvées**	Persons whose lives were at risk during a search and rescue incident, but who survived.
Loss	**Perte**	An injury or damage to health, property, the environment, or something else of value.
Maritime Incident	**Incident maritime**	A search and rescue incident on the water involving a vessel or a person, including the medical evacuation of person(s) from a vessel.
Matrix	**Matrice**	A tool where options are evaluated against set criteria to aid in the decision-making process.
Medical Evacuation (Medevac) - critical	**Évacuation médicale (Medevac) – critique**	The critical evacuation of injured or stranded persons from isolated Areas or the recovery of sick or critically injured persons from vessels at sea.
Medical Evacuation (Medevac) - routine	**Évacuation médicale (Medevac) – routine**	The routine medical evacuation of patients or vital medical resources from one medical facility to another (aeronautical or maritime ambulance service).
Monitoring	**Surveillance**	As part of the risk management decision process, the undertaking of a conscientious review of an operating environment or system and of its associated decision processes. The monitoring program has four key purposes: to detect and adapt to changing circumstances; to ensure that the activities are achieving the results expected of them; to ensure proper implementation of communication, control and residual risk strategies; to verify correctness of assumptions.

English	French	Definition
National SAR Secretariat (NSS)	**Secrétariat national de recherche et de sauvetage (SNRS)**	An autonomous arm's length organization within the Department of National Defense, accountable to the Lead Minister for Search and Rescue (Minister of National Defense). Established in 1986, the NSS is responsible for the management and coordination of the National Search and Rescue Program.
On-Scene Coordinator	**Coordonnateur sur les lieux**	The commander of a search and rescue unit designated to co-ordinate search and rescue operations within a specified search area.
Primary SAR Resources	**Ressources primaires de SAR**	Federal search and rescue aircraft and vessels, including those multi-tasked to SAR, established and equipped specifically for search and rescue, with search and rescue trained crews aboard. Primary search and rescue resources are under the direct operational control of the Search and Rescue Region Commander for search and rescue tasking and maintain a maximum 30-minute state of readiness.
Problem	**Problème**	An undesirable event or situation that has occurred or will certainly occur in the future. A **problem** is something you must deal with now, whereas a **risk** is something you should plan for in the future.
Rescue Coordination	**Coordination des opérations de sauvetage**	The function of integrating the efforts of search and rescue facilities and resources to achieve concerted and harmonized resolution of search and rescue incidents in an effective and efficient manner.
Residual Risk	**Risque résiduel**	The risk remaining after risk control strategies have been applied.
Risk	**Risques**	An expression of exposure to loss. 1. The potential of injury or loss, as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value. 2. The uncertainty that surrounds future events and outcomes. It is the expression of the likelihood and impact of an event with the potential to influence the achievement of an organization's objectives.

English	French	Definition
Risk Analysis	**Analyse des risques**	The systematic use of information to identify hazards and estimate the chance for, and severity of, injury or loss to individuals or populations, property, the environment or other things of value.
Risk Assessment	**Évaluation des risques**	The overall process of Risk Analysis and Risk Evaluation. It involves identifying risks and assessing the effects of those risks on program delivery and program effectiveness.
Risk Communications	**Communications des risques**	A set of communication and consultation activities designed to support the decision process by providing information necessary for defining stakeholder issues and for understanding the trade-offs inherent in the decision situation. **Any two-way communication between stakeholders about the existence, nature, form, severity or acceptability of risks.**
Risk Control Option	**Option de maîtrise des risques**	An action intended to reduce the frequency and/or severity of injury or loss, including a decision not to pursue an activity. Risk control options should be evaluated in terms of their cost, their effectiveness in reducing losses and their impact on other stakeholder objectives.
Risk Control Strategy	**Stratégie de maîtrise des risques**	A program which may include the application of several risk control options.
Risk Estimation	**Estimation des risques**	The activity of estimating the likelihood of a risk scenario occurring and estimating the impact on defined objectives if it does occur. The activity of estimating the frequency or probability and consequence of risk scenarios, including a consideration of the uncertainty of the estimates.
Risk Evaluation	**Évaluation des risques**	The process by which risks are examined in terms of cost and benefits, and evaluated in terms of their acceptability, considering the needs, issues, and concerns of stakeholders.
Risk Identification	**Détermination des risques**	The identification of situations that can negatively impact the achievement of the organization's objectives, described as risk scenarios.
Risk Management	**Gestion des risques**	The systematic application of management policies, procedures and practices to the tasks of analyzing, evaluating, controlling, and communicating about risk issues.

English	French	Definition
Risk Perception	**Perception des risques**	The significance assigned to risks by stakeholders. This perception is derived from the stakeholders' expressed needs, issues, and concerns.
Risk Scenario	**Scénario de risque**	A defined sequence of events with an associated likelihood and range of impact.
Search and Rescue (SAR)	**Recherche et sauvetage (SAR)**	Search and rescue comprises the search for, and provision of aid to, persons, ships or other craft which are, or are feared to be, in distress or imminent danger.
Search and Rescue Area	**Secteur de recherche et sauvetage**	Sub-divisions of the three Search and Rescue Regions, search and rescue Areas are statistical Areas created by the Department of National Defence for data collection purposes.
Search and Rescue case	**Cas de recherche et sauvetage**	Any situation where the search and rescue system respond or would have responded had it been alerted at the time the situation was happening.
Search and Rescue Incident	**Incident de recherche et de sauvetage**	Any reported situation which has the potential to require a response from the search and rescue (SAR) system. A SAR incident becomes a SAR case when the SAR system responds or would have responded had it been alerted at the time of the incident.
Search and Rescue Mission Coordinator (SMC)	**Coordonnateur de mission de recherche et sauvetage (CMRS)**	The official temporarily assigned to co-ordinate response to an actual or apparent distress situation.
Search and Rescue Region (SRR)	**Région de recherche et sauvetage (RRS)**	An area of defined dimensions associated with a Joint Rescue Coordination Centre within which search and rescue services are provided.
Search and Rescue Region Commander	**Commandant d'une région de recherche et sauvetage (CRRS)**	The person designated by the Chief of Defence Staff and authorized by the Canada Shipping Act, 2001 as being responsible for search and rescue operations within a Search and Rescue Region.
Search and Rescue Resource	**Ressource de recherche sauvetage**	A resource capable of responding to a search and rescue incident.

Annex C National Resource Description and Rating

PART 1: CCG Resources

*Notes to RAMSARD analyst: The supporting documents in this resource evaluation stem from the Fleet database, the Fleet Safety Manual, the Fleet Order 207, the SAR ifeboats statements of operational requirements, SVOP Instructor Training manual, and the RHIOT training manual.

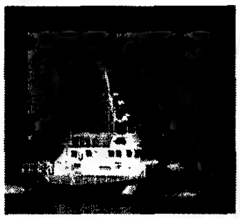
Resource	**Marine Resource Description & Rating (*estimate*)**	
CCG ZH 753(or 733) Fast Rescue Craft (includes Inshore Rescue Boat)	 **Provided thru www.ccg-gcc.ca**	7.53 metre rigid hull inflatable. Typical crew of 3, SAR equipped. Twin outboard engines or inboard diesel engine, high speed (40 knots+), electronic navigation suite, capsize reversal system. Towing equipment: Co-Polymer 3-Strand Rope

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	7	2	3	2	1	3	1	3	1	2	2	N/A	**27**

CCG 47' Motor Lifeboat (i.e Cap Breton)		Displacement of 18 tons & total length 14.6 m. Self-righting. Typical crew of 4. SAR equipped. Cruising speeds of 22 knots. Range of 200 nautical miles when cruising. Capable of operating at wind speeds of 50 knots & wave heights of 30 feet. Can tow ships with displacements of up to 150 tonnes and withstand 60 knots winds and 20 feet-high breaking waves. Towing Equipment: Nylon Braid Rope

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	4	5	5	4	4	4	5	3	3	4	N/A	**45**

CCG 52' Motor Lifeboat (i.e Cap-Aux-Meules)



Displacement of 36 tons & total length 15.8m.

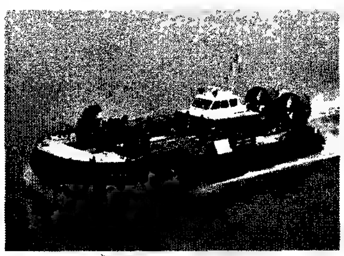
Typical crew of 4. SAR equipped.

Cruising speeds of 18 knots. Range of 250 nautical miles. Capable of operating at wind speeds of 50 knots & wave heights of 30 feet.

Towing Equipment: Nylon Braid Rope

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	3	4	5	5	4	4	4	5	3	3	4	N/A	**44**

CCG / Air Cushion Vehicle Hovercraft (i.e Mamilossa)



Type: Hovercraft

Length: 28.5 m

Beam: 12 m

Propulsion: 4 × Caterpillar C32 twelve-cylinder diesels each producing up to 1125HP

Speed: 50 knots (93 km/h; 58 mph) maximum

Range: max 400 nm

Endurance: 1 day

Complement: 6

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	7	4	1	4	4	4	4	2	3	2	4	N/A	**39**

CCG Mid-Shore Patrol (i.e Private Robertson V.C)

Net Tonnage of 75 tons & total length of 43m

Typical crew of 9.

Cruising speeds of 14 knots.

Range of 2000 nautical miles when cruising. Although, Vessel is intended for service in waters where the range to refuge is 250NM or less.

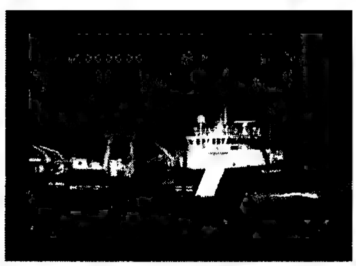
Capable of operating at speeds of 25 knots & wave heights of 4m.

Towing Equipment: Nylon Braid Rope

3 workboats (RHIB) available for rescue / recovery

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	7	3	4	4	4	4	4	3	3	4	N/A	**44**

CCG Offshore Fishery Science (i.e Alfred Needler)



Displacement of 1104.5 tons & length 50m.

Cruising speeds of 12 knots. Range of 3,000 nautical miles & endurance of 30 days.

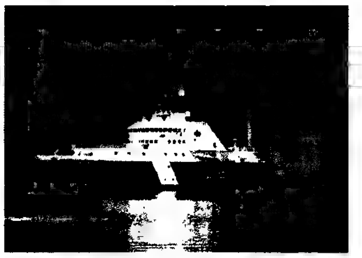
(2) workboats (RHIB) available for rescue / recovery

Typical crew of 21. SAR equipped. Vessel & crew have SAR and OSC capability.

Towing Equipment: Winch

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	2	7	5	4	5	4	5	5	3	3	4	N/A	**47**

CCG Offshore Oceanographic (i.e John P.Tully)



Displacement of 2195 tons & total length 68 m.

Cruising speeds of 10 knots. Range of 12,000 nautical miles & endurance of 50 days.

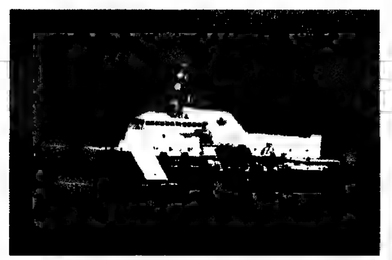
Helicopter flight deck for (1) Bell 206L or MBB Bo105

(2) workboats (1 RHIB & 1 lifeboat) available for rescue / recovery

Typical crew of 21. SAR equipped. Vessel & crew have SAR and OSC capability

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	2	7	5	4	5	4	5	5	3	3	4	N/A	47

CCG Offshore Patrol (i.e Leonard J.Cowley)



Displacement of 753.7 tons & total length 72m.

Cruising speeds of 12 knots. Range of 12600 nautical miles & endurance of 35 days.

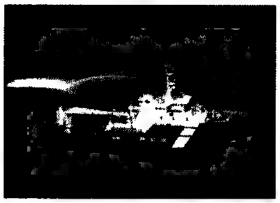
Typical crew of 19. SAR equipped. Vessel & crew have SAR and OSC capability.

(2) workboats (2 RHIBs) available for rescue / recovery

Towing Equipment: Wire Tow Line

Helicopter Flight deck with hangar

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	2	7	5	4	5	4	5	5	3	3	4	N/A	47

CCG Medium Endurance Multi-tasked (i.e Earl Grey)		Displacement of 1972 tons & total length 69.7 m. Cruising speeds of 11 knots. Range of 18000 nautical miles & endurance of 58 days. Typical crew of 24. SAR equipped. Vessel & crew have SAR and OSC capability. Towing Equipment: Winch (2) workboats (2 RHIBs) available for rescue / recovery

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	2	7	5	4	5	4	6	5	4	3	4	N/A	**49**

CCG High Endurance Multi-tasked (i.e Edward Cornwallis)		Gross Tonnage of 3727 tons & total length 83 m. Cruising speeds of 14 knots. Range of 6500 nautical miles & endurance of 120 days. Typical crew of 25. SAR equipped. Vessel & crew have SAR and OSC capability. Towing Equipment: Winch (2) workboats (1 RHIB and 1 barge) available for rescue / recovery Helicopter Flight deck with hangar

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	2	7	5	4	5	4	6	5	4	3	4	N/A	**49**

CCG Nearshore Fishery Research Vessel
(i.e Leim)

Gross Tonnage of 211 tons & total length 22 m.

Cruising speeds of 9 knots. Range of 1200 nautical miles & endurance of 7 days.

Typical crew of 5. SAR equipped.

Towing Equipment: Nylon Braid Rope

1 workboat (RHIB) available for rescue / recovery

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	1	5*	3	3	4	4	4	4	3	3	4	N/A	38

*Endurance on the LEIM is bound to crew lay days not the vessel max range.

CCG Light, Medium or Heavy Ice-breaker
(i.e Louis St-Laurent)

To deliver icebreaking services, the CCG has a fleet of 17 icebreakers: 2 heavy icebreakers, 4 medium icebreakers and 7 light (multi-tasked) vessels.

Sea keeping, range and endurance vary by vessel.

Typical crew varies & SAR capability will vary. Various communications & rescue capability available depending on vessel.

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	2	7	7	5	6	4	7	6	5	4	6	N/A	59

CCGA Dedicated Response Vessel

CCGA volunteers are experienced mariners who are familiar with the local environment and typically respond to more than 25% of all maritime incidents in Canada.

Some units operated community owned and dedicated SAR response vessels.

Vessel capabilities, equipment and training varies by region and unit

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	5	2	3	2	1	3	1	3	1	2	2	N/A	**25**

*Regional analysts will have to contact the local CCGA manager for vessels specifics. Rating might be higher or lower depending on the region.

CCGA Owner Operator

CCGA volunteers are experienced mariners who are familiar with the local environment and typically respond to more than 25% of all maritime incidents in Canada.

Some recreational boaters and commercial fishermen use personal vessels to assist the CCG with SAR operations, as well as boating safety education.

Vessel capabilities, equipment and training vary by region and unit.

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	2	2	1	1	1	2	1	2	1	1	1	N/A	**15**

*Regional analyst will have to consider that owner operator vessels types range from pleasure boats to fishing boats. And every other type in between. Above ratings are minimum-operating SAR baselines.

RCMP Patrol Vessel and/or Patrol RHIB

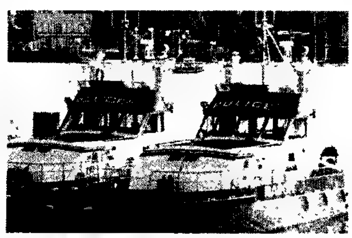
Titan Supermax patrol vessel, 7-meter RHIB, speed (30 knots+)

Sea keeping, range and endurance to be determined.

Various communications & rescue capability available. Typical crew of up to 4.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	7	2	2	2	1	2	1	2	1	1	2	N/A	23

RCMP Patrol Catamaran



High speed patrol 18-20 meter aluminum catamaran, speed (25 knots+)

Sea keeping, range and endurance limited. Primarily used in harbors & near shore.

Various communications & rescue capability available (Standard Tonnage associated equipment TC certified). Typical crew of 4.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	4	2	2	4	2	2	3	1	1	1	N/A	26

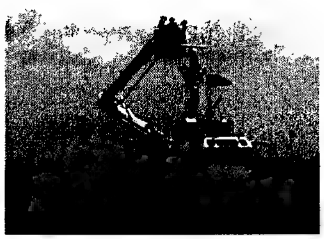
RCMP or City Police - Rigid Hull Inflatable

Rigid hull inflatable of varying lengths, vessel capabilities, equipment and training varies by region and police service.

Sea keeping, range and endurance vary. Primarily used in harbors & near shore.

Typical crew varies. Various communications & rescue capability available depending on vessel.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	6	2	2	2	2	2	1	2	1	1	2	N/A	23

<table>
<tr><td rowspan="1">City Fire Boat (i.e William Lyon Mackenzie)</td><td colspan="6"></td><td colspan="7">Specialized watercraft with pumps & nozzles designed for fighting shoreline and shipboard fires. May be used with firefighters, Emergency Medical Technicians, or physician with equipment. Some may be used as icebreakers,
Displacement of 200 tons & total length of 24.7m
Typical crew of 4.
Cruising speeds of 12 knots.
Sea keeping, range and endurance vary. Primarily used in harbor & near shore.
Firefighting equipment.
Aerial tower - 54' Amador/Trump Limited Giraffe
5 ton crane
2 Diesel driven water pumps
5 water nozzles
SAR capability will vary. Various communications & rescue capability available depending on vessel
1 workboat available for recovery</td></tr>
<tr><td rowspan="2">Estimated Rating</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td><td>L</td><td>Total Rating</td></tr>
<tr><td>1</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>1</td><td>1</td><td>4</td><td>1</td><td>4</td><td>N/A</td><td>21</td></tr>
</table>

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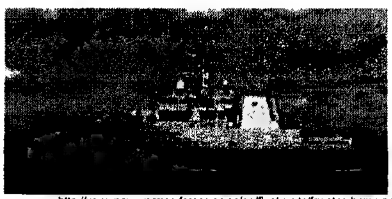
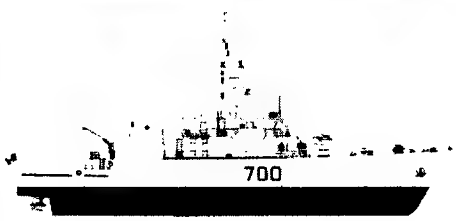
RCN Maritime Coastal Defence Vessel (MCDV)	 http://www.navy-marine forces.gc.ca/en/fleet-units/frigates-home page  	Designed for near coastal operations. They are Multi-role vessel can employ state-of-the-art technology to carry out a variety Search and Rescue missions. Displacement of 934 tons & total length of 55.3m Typical crew of 37. Cruising speeds of 15 knots. Capable of operating at speeds of 16 knots & wave heights of 2-3m. Although higher risk activities become difficult in sea state above 2m. 1 workboat (RHIB) available for rescue / recovery (depends on mission profile) Range at the economical cruising speed of 9 knots using two engines is 5,000 nautical miles and 15 knots max continuous speed; Vessel is self-sufficient for about 2 weeks. Vessel & crew have SAR and OSC capability.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	7	3	7	5	4	6	U/K	5	2	4	N/A	**47**

RCN Multi-Purpose Frigate (Halifax Class)	 http://www.navy-marine.forces.gc.ca/en/fleet-units/mcdv-home.page 	Warfare ships employing state-of-the-art technology to carry out a variety of missions. Capable of speed of 30 Kts; Displacement of 4770 t and Length of134 m. Range at cruising speed: 9500NM Sea keeping: Routinely operates in 3-4m seas. Higher risk activities such as boat work and flight operations become more difficult above 3m. Endurance: Can be self-sufficient for weeks, depending on speed of transit. Normal crew compliment 225. May carry CH-124 Sea King Helicopter. Or CH 148 Cyclone Helicopter Minimum of 2 RHIB available for rescue / recovery Vessel & crew have advanced SAR and OSC capability.

Estimated Rating	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**Total Rating**
	5	7	5	7	6	6	7	U/K	6	4	6	N/A	**59**

000389

PART 2: Air Resources

Air Resources	*Note: The coordinated aeronautical and maritime SAR system is operated in conjunction with the Royal Canadian Air Force (RCAF), which has been mandated by the Government to provide dedicated – primary SAR - aircraft and crews to respond to maritime SAR incidents. The CCG, other government departments (e.g. RCMP, Transport Canada), industry (charter aircraft) and CASARA (volunteer) are also available as Aircraft of Opportunity* *Air resources must be considered when designing marine SAR coverage and rating the capability of these resources will ensure that no undue reliance is placed on less capable resource.*

Primary RCAF Air Resources –CH 149 Cormorant

Speed of 150 Kts, Range of 750 NM and endurance of (TBD)

Crew size of 5 (2 SAR Tech)

Advanced survival support equipment and rescue hoist capability. Rear ramp & single side rescue door

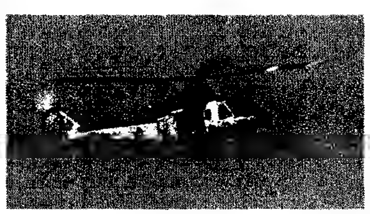
Aircraft is IFR and anti-icing capability for all weather operations.

Communications and electronic search capability.

Estimated Rating

A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
4	7	N/A	6	5	5	3	N/A	N/A	N/A	N/A	4	**34**

Primary RCAF Air Resources –CH 146 Griffon



Speed of 140 Kts. Range of 350 NM and endurance of (TBD)

Crew size of 4 (1 SAR Tech)

Limited survival support equipment (can be adjusted for mission requirements) Single side rescue door and rescue hoist capability

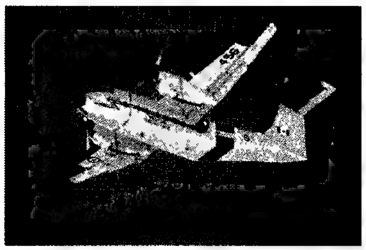
Aircraft is IFR and limited weather capability.

Limited communications and electronic search capability.

Estimated Rating

A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
3	3	N/A	5	3	5	3	N/A	N/A	N/A	N/A	4	**26**

RCAF (Primary) Air Resources – CC115 Buffalo



Speed of 225 Kts, Range of 1,200 NM and endurance of 6 hours

Crew size of 6 (2 SAR Tech)

Advanced survival support equipment and air delivery capability. Rear ramp.

Aircraft is IFR and anti-icing capability for all weather operations.

Communications for OSC capability, & electronic search capability.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	6	7	N/A	7	N/A	5	4	N/A	N/A	N/A	N/A	4	**33**

RCAF (Primary) Air Resources – CC130 Hercules

Speed of 320 Kts, Range of 3,900 NM and endurance of 12 hours

Crew size of 7 (2 SAR Tech)

Advanced survival support equipment and air delivery capability. Rear ramp.

Aircraft is IFR and anti-icing capability for all weather operations.

Communications for OSC capability, & electronic search capability.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	6	7	N/A	7	N/A	5	4	N/A	N/A	N/A	N/A	4	**33**

RCAF (Primary) Air Resources – C295W

* Speed of 260 Kts, Range of 2,000 NM and endurance of 12 hours

Crew size of 5 (2 SAR Tech)

Advanced survival support equipment and air delivery capability. Rear ramp.

Aircraft is IFR and anti-icing capability for all weather operations.

Communications for OSC capability, & electronic search capability

* *All specifications are only estimated at this time.*

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	5	7	N/A	7	N/A	5	4	N/A	N/A	N/A	N/A	4	**32**

CCG (Secondary) Air Resources –Bell 212

Speed of 100 Kts, Range of 290 NM and endurance of 2.5 hrs (TBC).

Crew of 1 pilot (9 passengers)

SAR capability limited. Side doors.

Aircraft is VFR capability for daytime operations.

Communications (air & marine) capability.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	3	3	N/A	2	1	1	1	N/A	N/A	N/A	N/A	1	**12**

CCG (Secondary) Air Resources –Bell 206 L

Speed of 100 Kts, Range of 262 NM and endurance of 2 hrs (TBC)

Crew of 1 pilot (5 passengers)

SAR capability limited. Side doors.

Aircraft is VFR capability for daytime operations.

Communications (air & marine) capability.

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	3	2	N/A	2	N/A	1	1	N/A	N/A	N/A	N/A	1	10

CCG (Secondary) Air Resources –MBB 105

Speed of 110 Kts, Range of 217 NM and endurance of 2.6 hrs (TBC)

Crew of 1 pilot (4 passengers)

SAR capability limited. Side doors & rear clamshell.

Aircraft is VFR capability for daytime operations.

Communications (air & marine) capability.

Estimated Rating	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
	3	2	N/A	2	N/A	1	1	N/A	N/A	N/A	N/A	1	10

Air Resources (Secondary) – Government of Canada (Transport Canada / RCMP)

Provided thru Transport Canada: https:// www.tc.gc.ca/eng/marinesafety/oep-ers-nasp-2195.htm

Speed & Range and Endurance dependent on aircraft type

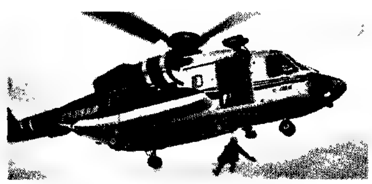
Crew size varies.

Visual search capability. Some aircraft may carry FLIR or advanced electronics.

Aircraft may be IFR and anti-icing capability for all weather operations.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	5	N/A	5	N/A	1	1	N/A	N/A	N/A	N/A	1	17

Air Resources (Secondary) – Cougar SAR Helicopter (S-92)



Speed of 165 Kts, Range of 439 NM and endurance of (TBD)

Crew size of 2 (1 Rescue Specialist &/or up to 10 passengers)

Survival support equipment and rescue hoist capability. Single side rescue door

Aircraft is IFR and anti-icing capability for all weather operations.

Communications and advanced electronic search capability.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	4	N/A	6	4	3	2	N/A	N/A	N/A	N/A	4	23

Air Resources (Secondary) – PAL Aerospace

PAL Aerospace: https://www.ainonline.com/aviation-news/defense/2017-11-11/pal-isr-patroller-multiplies-force

Speed & Range and Endurance dependent on aircraft type.

Crew size varies.

Visual search capability. Some aircraft may carry FLIR or advanced electronics.

Aircraft may be IFR and anti-icing capability for all weather operations.

	A	B	C	D	E	F	G	H	I	J	K	L	Total Rating
Estimated Rating	4	4	N/A	5	0	1	2	N/A	N/A	N/A	N/A	1	17

<table>
<tr><td rowspan="1">Air Resources (Secondary) – CASARA</td><td colspan="13">
Speed & Range and Endurance dependent on aircraft type (Speed normally less than 115 Kts, range of -250 NM and -2 hrs endurance).
Crew size 2 to 3 (pilot, navigator and spotter).
Visual search capability.
Aircraft normally VFR capability for daytime operations only (some may have night endorsement). Must remain within gliding distance of land for single engine aircraft.</td></tr>
<tr><td rowspan="2">Estimated Rating</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td><td>L</td><td>Total Rating</td></tr>
<tr><td>3</td><td>2</td><td>N/A</td><td>2</td><td>0</td><td>1</td><td>1</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>1</td><td>10</td></tr>
</table>

** The twelve (12) SAR capabilities and their associated rating criteria are to be used as a reference for rating of Marine (& Air) Resources (see SAR Capability Rating for further information):*

A. Speed;
B. Endurance / Range;
C. Sea keeping;
D. Search;
E. Survivor Recovery/Care/Transportation;
F. First Aid / Medical;
G. On Scene Coordination;
H. Towing;
I. Fire Protective Equipment;
J. Dewatering;
K. Redundancy; and
L. Survival Support (Aviation only).

Note:
- ***A-K** are marine SAR Capabilities; and*
- ***A, B, D, E, F, G, L** are Air SAR Capabilities.*

Climate of the Canadian Coast Guard Arctic Region SAR Areas

Submitted to

Canadian Coast Guard / Garde Côtière Canadienne
Fisheries and Oceans Canada / Pêches et Océans Canada
St. John's, NL

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August 2018

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1.0 Introduction

This document examines the climate of each of the Arctic Region Search and Rescue (SAR) Areas 010, 155, 259 and 260. Where possible, climate statistics are based on a standard 30-year period, which is considered short enough to minimize the effects of long-term climate change on the statistics, yet long enough to reduce the impact of anomalous events.

Climate statistics are compiled according to three-month seasons that are defined as follows:

Winter	December, January, February (DJF)
Spring	March, April, May (MAM)
Summer	June, July, August (JJA)
Autumn	September, October, November (SON)

Results are presented for the following parameters: wind speed and direction, wave height and direction, air and sea surface temperature, sea ice coverage, and sea ice type.

Throughout the report, wind and wave directions follow standard meteorological convention and refer to the direction from which the winds and waves are coming.

2.0 Data Sources

The data sources to describe the climatology within the project area came from five sources: the MSC50 North Atlantic wind and wave hindcast data base, the MSC Beaufort wind and wave hindcast data base, the International Comprehensive Ocean-Atmosphere Data Set (ICOADS), the Integrated Surface Database and the Canadian Ice Service Sea Ice Climatic Atlas. The International Ice Patrol Iceberg Sightings Database does not cover either of the Arctic SAR Areas.

The locations of the climate data sources are presented in Figure 2.1.

It should also be noted that wind speeds from the hindcast and ICOADS data sets are not directly comparable to each other due to their sampling period and the heights at which they were measured. Wind speed is dependent on height since the wind speed increases at increasing heights above sea level. Methods to reduce wind speeds from anemometer level to 10 m have proven ineffective due to atmospheric stability issues. Winds in the ICOADS data set were either estimated or measured by anemometers at various heights above sea level.

Winds speeds from each of the data sources have different averaging periods. The MSC50 and Beaufort winds are 1-hour averages while the ICOADS and ISD winds are 10-minute average winds.

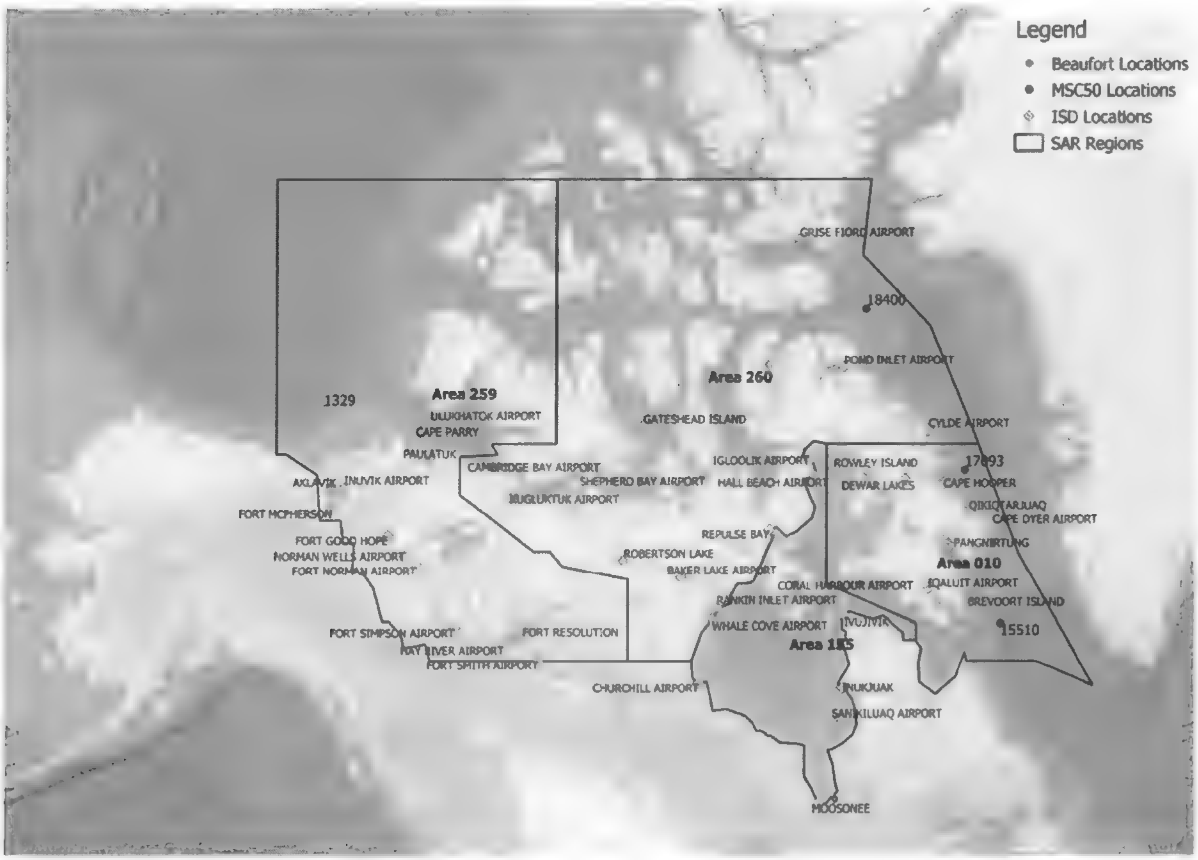

Figure 2.1 Locations of the Climate Data Sources

2.1 ICOADS

Wind, wave and sea surface temperature statistics for the area were compiled using data from the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) Release 3.0 (Freeman, et al., 2017) Enhanced Trimming data set. A subset of global marine surface observations from ships, drilling rigs, and buoys for the area covering the period from January 1986 to December 2015 was used in this report.

The Enhanced Trimming data set was trimmed to exclude outliers which fall outside of 4.5 standard deviations from the smoothed median. Despite this analysis, valid observations may still have been excluded from the data set. Conversely, invalid data which fell within the limits of the quality control analysis may have been included in the data set.

While the ship-based reports have been quality controlled to the extent possible, they are likely to contain some observation errors in addition to position report errors, particularly for the older reports. As well, the data set is known to contain a 'fair weather bias', which arises for the following reasons: ship's captains may choose to avoid areas of heavy weather, and since the reporting program is voluntary, fewer observations are likely to be taken under adverse weather and sea state conditions. This bias is more likely to be present during the winter season and over temperate and northern seas where vessel traffic is light.

Kent et al. (1993) demonstrated various systematic inconsistencies in the meteorological observations from voluntary observing ships. These inconsistencies were mostly dependent on the method of estimation that was used. Sea surface temperature data from engine intake thermometers were found to be biased high by an average of 0.3°C. The dew point temperatures from fixed thermometer screens were biased high compared to psychrometer readings. The magnitude of the bias was of the order of 1°C and varied with dew point temperature. Wind speeds from anemometers were biased high compared to visual winds by about two knots for winds up to about 25 knots. It was unknown whether visual winds or anemometer winds were more accurate. Compared to daytime values, visual winds at night were underestimated by about 1 m/s at 15 m/s and 5 m/s at 25 m/s.

2.2 MSC50 Data Set

Wind and wave climate statistics for SAR Area 010 and 260 were extracted from the MSC50 North Atlantic wind and wave climatology data base compiled by Oceanweather Inc under contract to Environment Canada. The MSC50 data base consists of continuous wind and wave hindcast data in 1-hour time steps from January 1954 to December 2015, on a 0.1° latitude by 0.1° longitude grid. A subset of the MSC50 data set from 1986 to 2015 for grid points 15510 (SAR Area 010) and 18400 (SAR Area 260) was chosen to represent conditions within the areas of interest. Wave heights and periods in the MSC50 data base are computed using a Pierson Moskowitz spectrum.

2.3 Beaufort Data Set

Wind and wave climate statistics for SAR Area 259 were extracted from the MSC Beaufort wind and wave climatology data base compiled by Oceanweather Inc under contract to Environment Canada. The Beaufort data base consists of continuous wind and wave hindcast data in 3-hour time steps from January 1970 to December 2015, on a 0.25° latitude by 0.25° longitude grid. A subset of the MSC50 data set from 1986 to 2015 for grid point 01329 was chosen to represent conditions within the area of interest. Wave heights and periods in the MSC50 data base are computed using a Pierson Moskowitz spectrum.

Grid point locations with greater than 50% ice concentration are considered as land with no wave generation and/or propagation. In the MSC Beaufort the ice edge was allowed to change on a weekly basis which allowed better representation of the changing ice conditions during the transition periods.

2.4 Integrated Surface Database

The Integrated Surface Database (ISD) consists of global hourly and synoptic observations compiled from numerous sources into a single common ASCII format and common data model. The database includes over 35,000 stations worldwide, with some having data as far back as 1901, though the data show a substantial increase in volume in the 1940s and again in the early 1970s. Currently, there are over 14,000 "active" stations updated daily in the database. ISD includes numerous parameters such as wind speed and direction, wind gust, temperature, dew point, cloud

data, sea level pressure, altimeter setting, station pressure, present weather, visibility, precipitation amounts for various time periods, snow depth, and various other elements as observed by each station (Smith, Lott, & Vose, 2011).

Station Name	SAR Area	Callsign	Latitude	Longitude	Elevation	Begin Date	End Date
Rowley Island	010	CWRX	69.070	-79.070	410	19981224	20120208
Longstaff Bluff	010	CWLX	68.883	-75.133	1610	19571202	20120208
Dewar Lakes	010	CWUW	68.650	-71.167	5270	19770701	20120208
Cape Hooper	010	CWUP	68.467	-66.817	3900	19570801	20120208
Pangnirtung	010	CYXP	66.133	-65.700	230	19340101	20120208
Cape Dyer Airport	010	CWFD	66.650	-61.383	3930	19551208	20120208
Qikiqtarjuaq	010	CYVM	67.550	-64.016	60	19790131	20120208
Brevoort Island	010	CWOB	63.333	-64.150	3760	19600428	20120208
Iqaluit Airport	010	CYFB	63.750	-68.550	340	19420301	20101231
Kimmirut A Nwt	010	CYLC	62.850	-69.883	530	19340101	20120208
Cape Dorset Airport	010	CYTE	64.233	-76.533	480	19770701	20101231
Whale Cove Airport	155	CYXN	62.233	-92.600	200	19781205	20120207
Hall Beach Airport	155	CYUX	68.767	-81.233	80	19570801	20120208
Repulse Bay	155	CYUT	66.517	-86.217	240	19781205	20120208
Fort Severn	155	CYER	56.017	-87.667	160	20061030	20120208
Churchill	155		58.733	-94.050	290	19940211	20120208
Moosonee Awos/Ua	155	CYMO	51.283	-80.600	90	19820101	20120208
Inukjuak Airport	155	CWPH	58.467	-78.083	250	19340101	20120208
Inukjuak Airport(Sawr)	155	CYPH	58.467	-78.083	250	19880725	20101014
Ivujivik	155	CYIK	62.417	-77.917	380	19880621	20120208
Sanikiluaq Airport	155	CYSK	56.533	-79.250	320	19781205	20120208
Churchill Airport	155	CYYQ	58.733	-94.050	290	19430101	20101231
Coral Harbour Airport	155	CYZS	64.200	-83.367	640	19430301	20120207
Norman Wells Airport	259	CYVQ	65.283	-126.800	730	19450101	20120208
Fort Good Hope	259	CYGH	66.233	-128.650	820	19340101	20120208
Fort Resolution	259	CYFR	61.183	-113.683	1600	19340101	20120208
Fort Smith Airport	259	CYSM	60.017	-111.967	2050	19340101	20120208
Hay River Airport	259	CYHY	60.833	-115.783	1650	19340101	20120208
Fort Simpson Airport	259	CYFS	61.767	-121.233	1690	19340101	20120208
Cape Parry	259	CZCP	70.167	-124.700	870	19570101	20120208
Paulatuk	259	CYPC	69.350	-124.050	50	19830725	20120208
Ulukhatok Airport	259	CYHI	70.750	-117.800	360	19500101	20120208
Inuvik Airport	259	CYEV	68.300	-133.483	680	19581113	20120208
Fort Mcpherson	259	CZFM	67.400	-134.850	350	19781205	20120208
Aklavik	259	CYKD	68.217	-135.000	60	19781205	20120208

Fort Norman Airport	259	CZFN	64.917	-125.567	980	19340101	20120208
Igloolik Airport	260	CYGT	69.367	-81.817	510	19791219	20120208
Rankin Inlet Airport	260	CYRT	62.817	-92.117	320	19810206	20120208
Cylde Airport	260	CYCY	70.483	-68.517	270	19770701	20120208
Pond Inlet Airport	260	CYIO	72.683	-77.967	620	19340101	20120208
Gateshead Island	260	CNGH	70.633	-100.267	200	19770701	20120208
Robertson Lake	260	CWTD	65.099	-102.433	2440	19800301	20120208
Shepherd Bay Airport	260	CYUS	68.817	-93.433	430	19770701	20120208
Grise Fiord Airport	260	CWGZ	76.417	-82.900	450	19781116	20120208
Cambridge Bay Airport	260	CYCB	69.100	-105.133	270	19341001	20120208
Baker Lake Airport	260	CYBK	64.300	-96.067	180	19460201	20120208
Kugluktuk Airport	260	CYCO	67.817	-115.133	230	19340101	20120208

2.5 Canadian Ice Service Sea Ice Climatic Atlas

Sea ice data was extracted from weekly digital sea ice climatic charts compiled by the Canadian Ice Service, which cover the 30-year period 1981 to 2010. The following statistical datasets were used: 30-year median ice concentration, 30-year frequency of presence of sea ice, and 30-year median of predominant ice type when ice is present. Each weekly sea ice climatic chart was assumed to represent conditions for the following six days up to the subsequent weekly ice chart. The results are presented as follows:

- the mean number of days per season that ice with concentration greater than 7/10 and thickness greater than 15 cm is present within the area,
- when ice with concentration greater than 7/10 and thickness greater than 15 cm is present, the mean fraction of the SAR area that is covered by that ice, expressed as a percentage, and
- the seasonal presence of old and first-year ice (includes new, grey, and grey-white ice) within the SAR area, expressed simply as yes (Y) or no (N).

2.5.1 Frequency of Presence

The "Frequency of Presence of Sea Ice (%)" charts consider the likelihood of total concentration of ice greater than or equal to 1/10 throughout the course of a year and give an idea of the likelihood that ice will occur at a particular location for the appropriate date.

The charts can be interpreted as the "odds of encountering sea ice for the dataset". The charts depict above normal extent (1 to 33%), near normal extent (34 to 66%) and below normal extent (67 to 99%). The 0% line represents the maximum extent of sea ice, beyond it no ice was reported in the dataset; the 100% line represents the minimum extent of sea ice, within it there has always been ice reported in the dataset. (Environment and Climate Change Canada, 2018).

2.5.2 Median Concentration of Sea Ice

The "Median of Ice Concentration" data base considers total concentration of ice on a weekly period from January 01 to July 30. The charts do not represent any real ice season but rather a statistical composite of all available seasons.

The charts represent the statistical "normal" ice concentration for the appropriate date. (Environment and Climate Change Canada, 2018)

2.5.3 Predominant Ice Type

The 30-Year Median of Predominant Ice Type when Ice is Present considers the ice type of greatest concentration. These charts represent the statistical normal predominant ice type when ice is present for the appropriate date (Environment and Climate Change Canada, 2018).

3.0 Description of the Climate

The climates of the Canadian Arctic and Hudson Bay are generally polar to sub-arctic in nature and are characterized by long, cold winters and short, cool summers. Every month in a polar climate has a mean temperature of less than 10°C. A sub-arctic climate is classified as having temperature ranges of -40°C in the winter to greater than 30°C in the summer. At least one month must have an average temperature exceeding 10°C.

At any given time, the upper level flow is a wave-like pattern of large and small amplitude ridges and troughs. These ridges and troughs tend to act as a steering mechanism for surface features and therefore their positions in the upper atmosphere determine the weather at the earth's surface. Upper ridges tend to support areas of high pressure at the surface, while upper troughs lend support to low pressure developments. The amplitude of the upper flow pattern tends to be higher in winter than summer, which is conducive to the development of more intense storm systems.

Studies (Archer & Caldeira, 2008) have shown that there exists a poleward shift of the jet stream, and consequently storm tracks, at a rate of 0.17 to 0.19 degrees/decade in the northern hemisphere. This shift has been related to an increase in the equator-to-pole temperature gradient. McCabe et al (2001) obtained similar results, finding that there has been a decrease in mid-latitude cyclone frequency and an increase in high-latitude cyclone frequency.

By summer, the main storm tracks have moved further north than in winter. Low-pressure systems are much weaker, however more frequent. With increasing solar radiation during spring, there is a general warming of the atmosphere that is relatively greater at higher latitudes. This decreases the north-south temperature contrast, lowers the kinetic energy of the westerly flow aloft and decreases the potential energy available for storm development. Concurrently, there is a northward shift of the main band of westerly winds at upper levels and a marked development of the Bermuda-Azores sub-tropical high-pressure area to the south. This warm-core high-pressure cell extends from the surface through the entire troposphere. The main track of the weaker low-pressure systems typically lies through the Labrador region and tends to be oriented from the west-southwest to the east-northeast.

Extratropical storms generally follow an east-west track across the region, although storms originating over central or eastern Canada often curve northward and affect areas of the eastern Arctic. The life cycle of arctic low-pressure systems is determined by a number of factors, including topography, sea-ice concentration, and a sharp contrast in temperature over a short distance. Favored areas for the formation of lows over the Arctic include the lee side of mountains, expanses of open water that are warmer / colder than the surrounding land, and the ice edge. (Environment and Climate Change Canada, 2017)

Environment and Climate Change Canada undertook a detailed analysis of the formation, movement and dissipation of low pressure systems using the Arctic System Reanalysis (ASR) data set (Environment and Climate Change Canada, 2017). This analysis led to the identification of 20 principle storm tracks which affect the Arctic region. Since storm tracks are dependent on the time of year, two plotted maps were developed; one covering the period from June through August (Figure 3.1) and the other, from September through November (Figure 3.2). Only storms that maintained a closed, low- pressure centre for at least 48 hours were included.

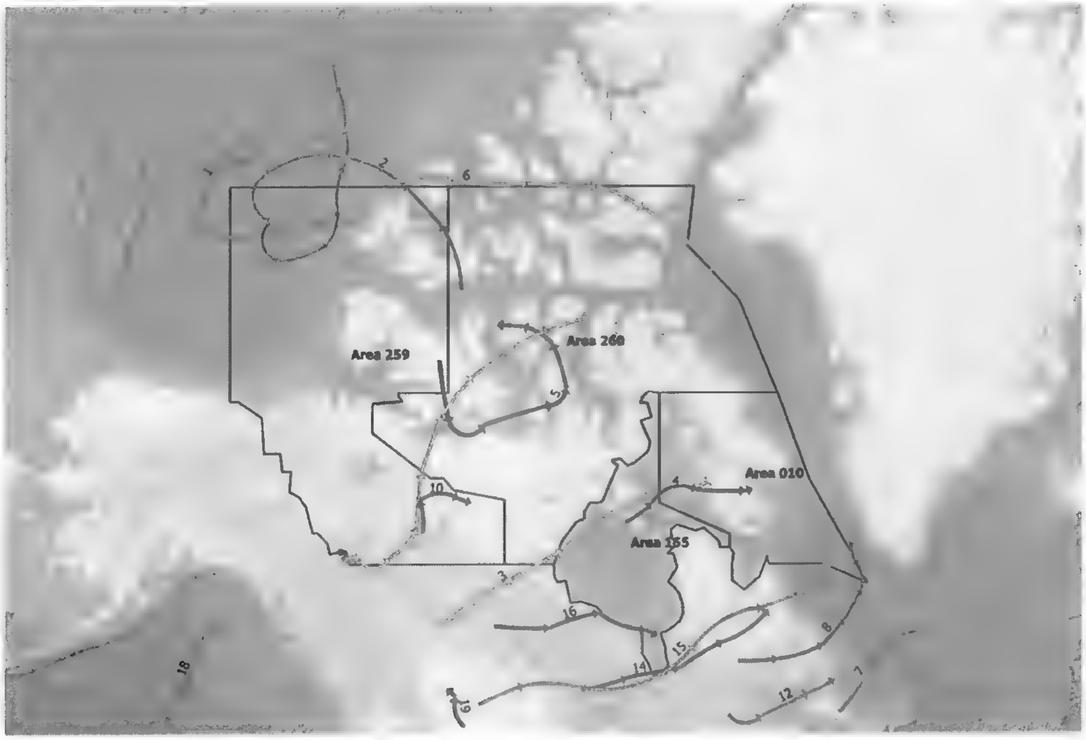

Figure 3.1 The 20 Principle Storm Tracks for June, July and August (adapted from (Environment and Climate Change Canada, 2017))

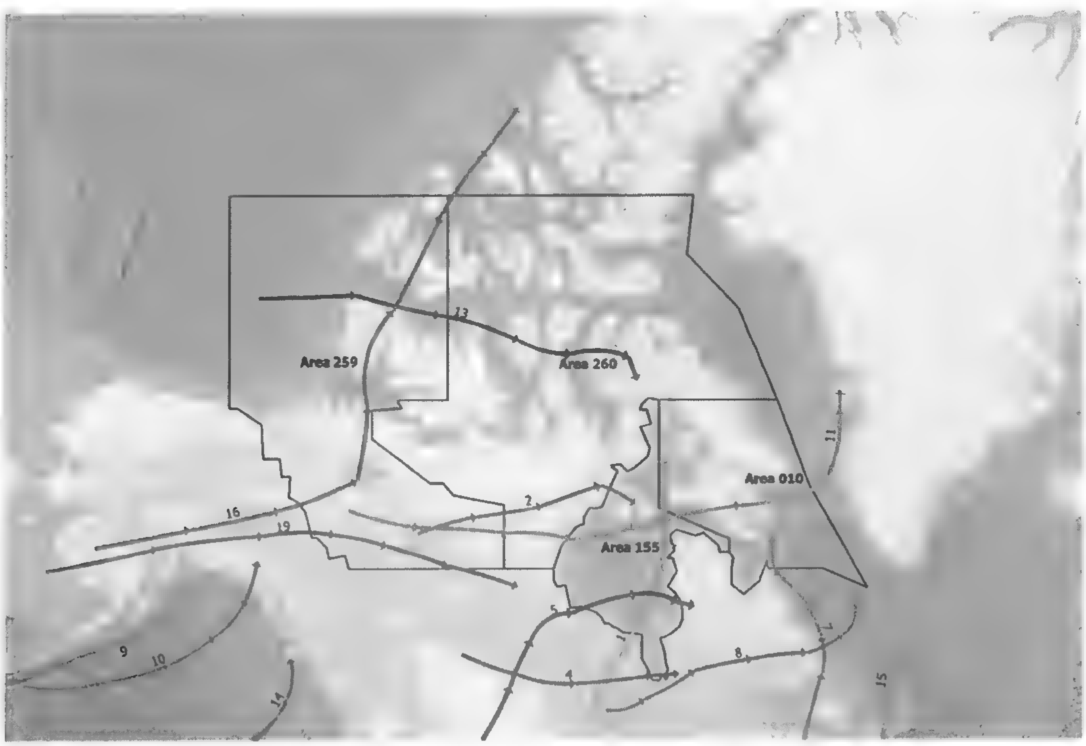

Figure 3.2 The 20 Principle Storm Tracks for September, October and November (adapted from (Environment and Climate Change Canada, 2017))

The significant wave height is defined as the average height of the 1/3 highest waves, and its value roughly approximates the characteristic height observed visually. The maximum height is the greatest vertical distance between a wave crest and adjacent trough.

A wave system may be composed of the wind wave alone, swell alone, or the wind wave in combination with one or more swell groups. A swell is a wave system not produced by the local wind blowing at the time of observation and may have been generated within the local weather system, or from within distant weather systems. The former situation typically arises when a front, trough, or ridge crosses the point of concern, resulting in a marked shift in wind direction. Swells generated in this manner are usually of low period. As the swell advances, its crest becomes rounded and its surface smooth. As a result of the latter process, swell energy may propagate through a point from more than one direction at a particular time.

Wind sea growth is often limited by proximity to land or sea ice and the highest waves in the area are normally experienced furthest from shore, where the distance from land and/or the ice edge is greatest. Swells are limited throughout much of the Arctic SAR areas as well due to the proximity of land and the presence of sea ice year-round. The largest waves within the Arctic SAR Areas would form from northwesterly winds within the Davis Strait when ice is not present.

Sea Ice is present throughout the year in each of the 4 SAR Areas however conditions vary depending on location and time of year. Thick ice, defined as ice with a thickness greater than 15 cm and concentration greater than 7 tenths, can be expected in all areas throughout the year, however the probability of encountering thick sea ice is low in SAR Areas 010 and 155 during Autumn. Thick sea ice is much more prevalent in the Western Arctic.

3.1 SAR Area 010

3.1.1 Wind Speed and Direction

Wind speed statistics from the MSC50, ISD and ICOADS data sets for SAR Area 010 are presented in Table 3.1 through Table 3.3. Annual wind speed vectors are provided in Figure 3.3. The highest absolute maximum wind speed of 53.1 knots was recorded in the ICOADS data set during both the winter and autumn seasons. Wind speeds from all ISD locations within Area 010 were combined to produced the statistics in Table 3.2.

Wind roses of the seasonal wind speed and direction, the associated histogram of the wind speed frequency and the wind speed percentage exceedance plots for the MSC50 Grid Point 15510 located at 62.0°N; 60.5°W are presented in Figure 3.4 through Figure 3.15.

Winds are generally from the north-northwest to west-northwest, with the predominant wind, being a 10 - 20 knot west-northwesterly wind during the winter months and a 10 – 20 knots northwesterly wind during Spring. As summer approaches, the predominate wind decreases to 0 – 10 knots from a west-northwesterly direction. By autumn, predominate winds become northwesterly again with speeds of 10-20 knots (Table 3.4 through Table 3.7).

Gale force winds are more frequent during the winter months. Wind speeds greater than 30 knots occur 4.5% of the time during the winter months, but only 0.1% of the time during the summer.

Table 3.1 SAR Area 010 Seasonal Wind Speed Statistics from MSC50 Grid Point 15510 (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	17.5	7.4	39.7	47.4
Spring	13.4	6.7	33.4	42.0
Summer	10.5	5.5	28.7	34.9
Autumn	16.7	7.2	39.2	47.4

Table 3.2 SAR Area 010 Seasonal Wind Speed Statistics from the ISD data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	12.0	8.5	49.7	50.0
Spring	11.4	7.6	44.0	45.1
Summer	10.3	6.3	37.0	38.1
Autumn	13.1	8.4	49.1	46.8

Table 3.3 SAR Area 010 Seasonal Wind Speed Statistics from the ICOADS data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	19.8	10.1	40.1	53.1
Spring	12.5	6.6	26.7	40.8
Summer	11.0	6.5	36.5	40.0
Autumn	14.7	8.6	46.2	53.1

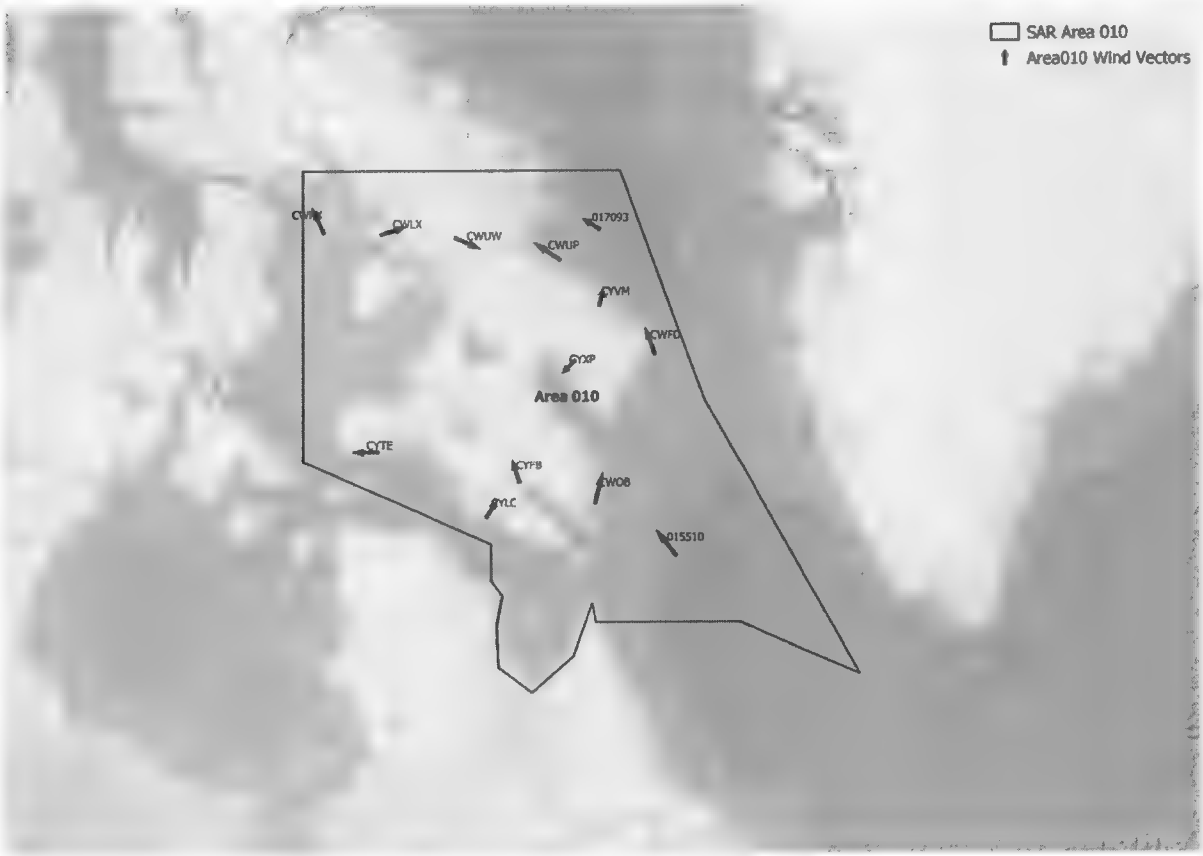

Figure 3.3 Annual Wind Vectors for SAR Area 010

Table 3.4 SAR Area 010 Winter Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 15110)

Source: MSC50 | Total Samples: 21647

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	0.95	1.29	0.90	0.77	0.61	0.50	0.49	0.60	0.66	0.77	0.89	1.39	2.14	2.75	2.53	2.29	20.13
	10 - 20	2.06	2.31	1.59	1.22	1.05	1.03	0.92	0.89	0.57	0.79	1.23	2.67	6.68	9.39	9.37	5.76	49.00
	20 - 30	1.30	1.61	0.89	0.60	0.61	0.50	0.37	0.35	0.26	0.17	0.25	1.04	2.71	5.41	5.32	3.71	26.36
	30 - 40	0.29	0.34	0.22	0.14	0.11	0.14	0.07	0.03	0.01	0.03	0.04	0.19	0.40	0.57	0.80	0.80	4.43
	40 - 50	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.09
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Rose for SAR Area 010 Grid Point 15510
Winter

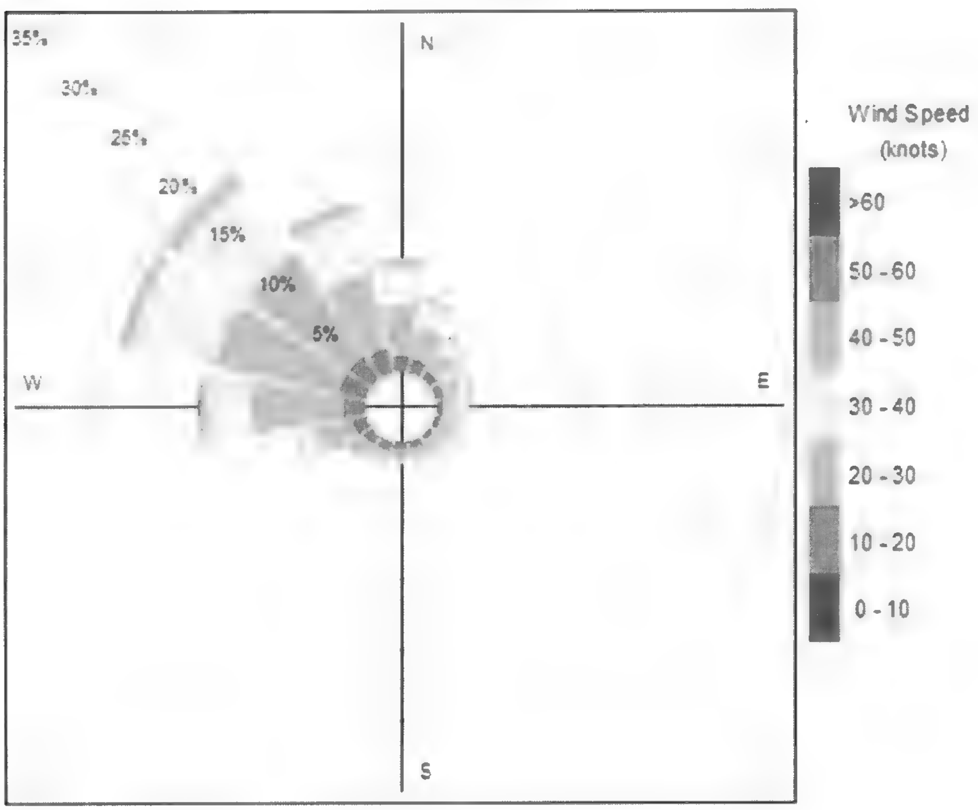

Figure 3.4 SAR Area 010 Winter Wind Rose (Grid Point 15510)

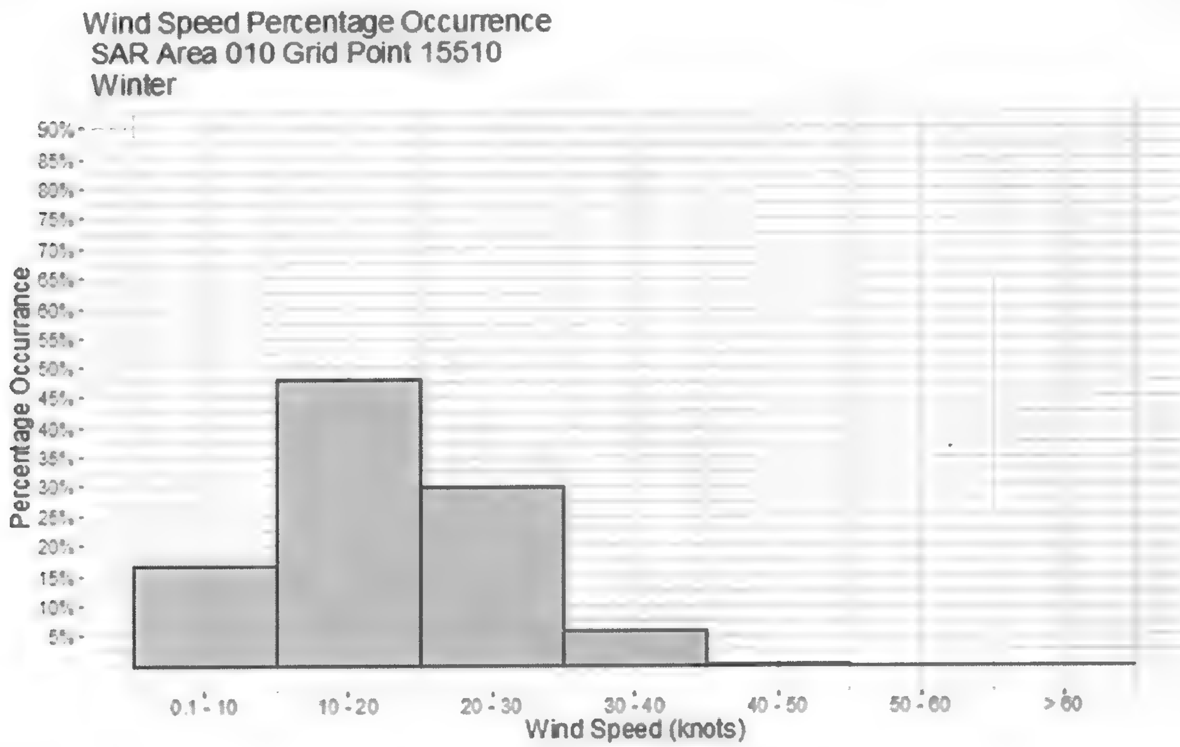

Figure 3.5 SAR Area 010 Winter Wind Speed Percentage Occurrence (Grid Point 15510)

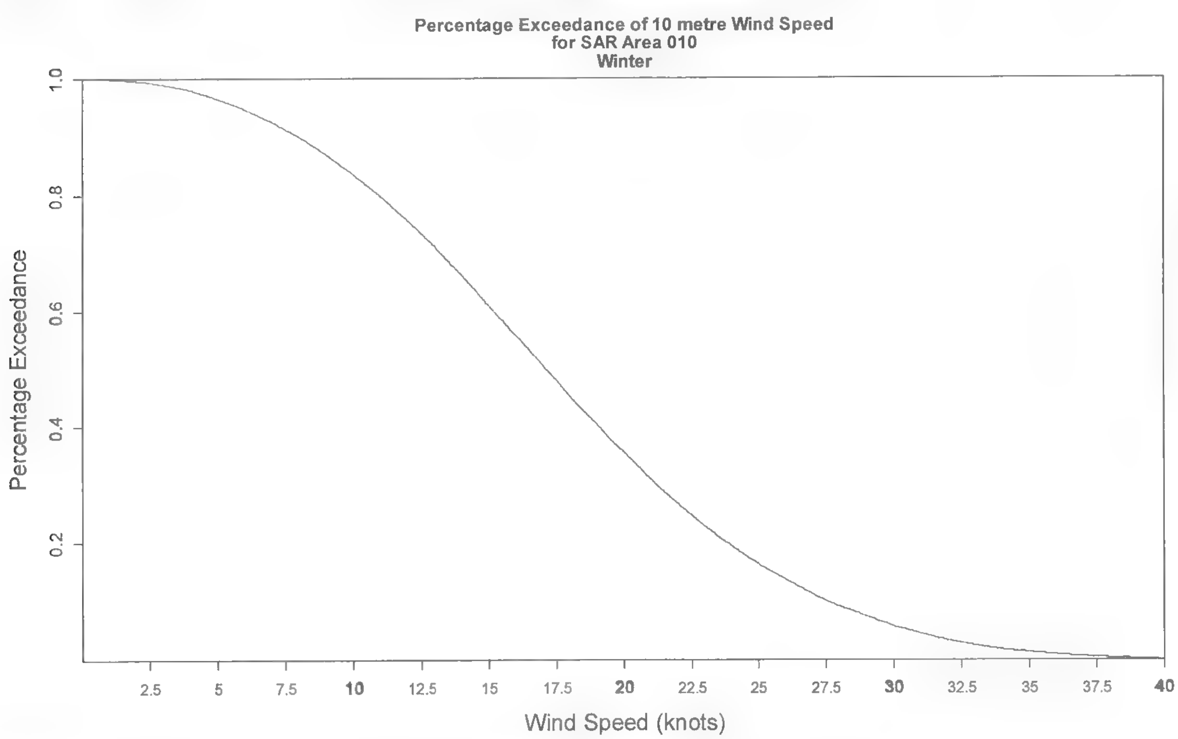

Figure 3.6 SAR Area 010 Winter Wind Speed Percentage Exceedance (Grid Point 15510)

Table 3.5 SAR Area 010 Spring Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 15510)

Source: MSC50 | Total Samples: 22055

	Wind Direction (true / from)																
Wind Speed (knots)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	1.61	2.44	1.81	1.88	2.04	1.95	1.83	1.67	1.41	1.37	1.47	2.13	3.24	4.56	4.83	4.28	39.78
10 - 20	2.56	2.48	2.04	1.61	1.94	1.95	1.64	1.52	0.68	0.76	0.92	1.76	3.33	6.81	8.56	6.08	46.57
20 - 30	0.88	0.96	0.46	0.42	0.42	0.43	0.44	0.23	0.08	0.09	0.15	0.36	1.06	1.60	2.48	1.78	12.67
30 - 40	0.04	0.07	0.01	0.04	0.03	0.05	0.01	0.00	0.00	0.00	0.01	0.07	0.05	0.09	0.17	0.26	0.98
40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

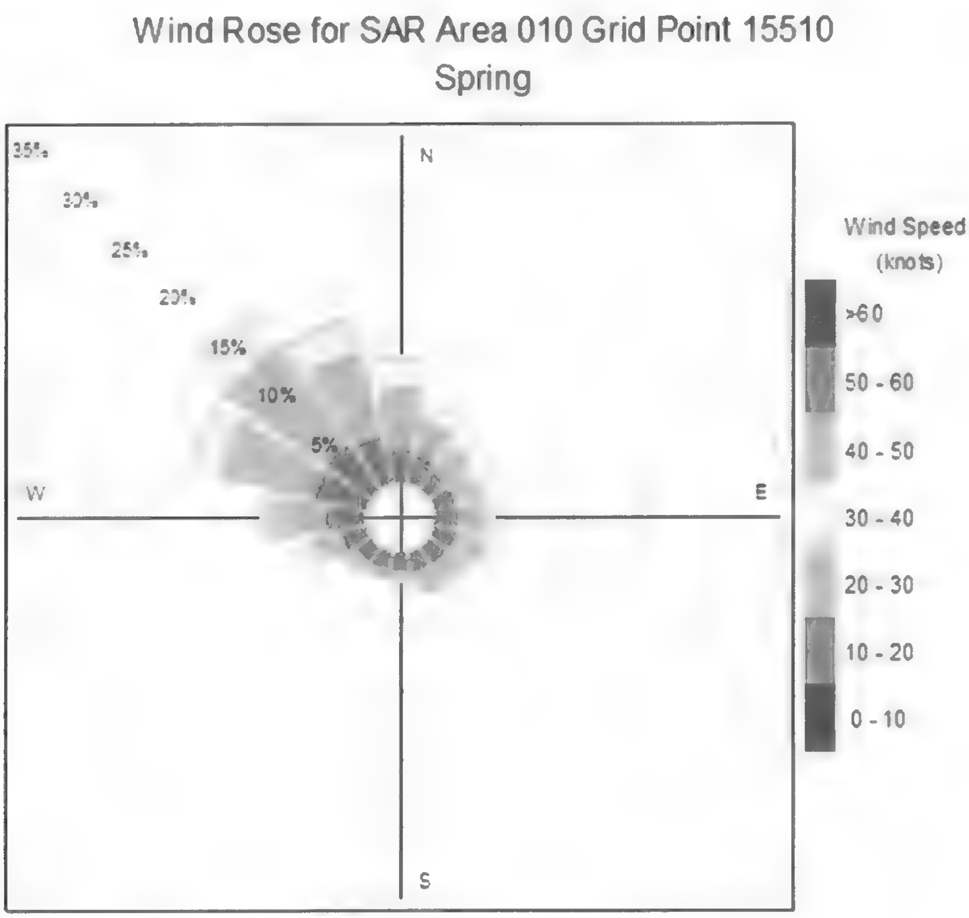

Figure 3.7 SAR Area 010 Spring Wind Rose Diagram (Grid Point 15510)

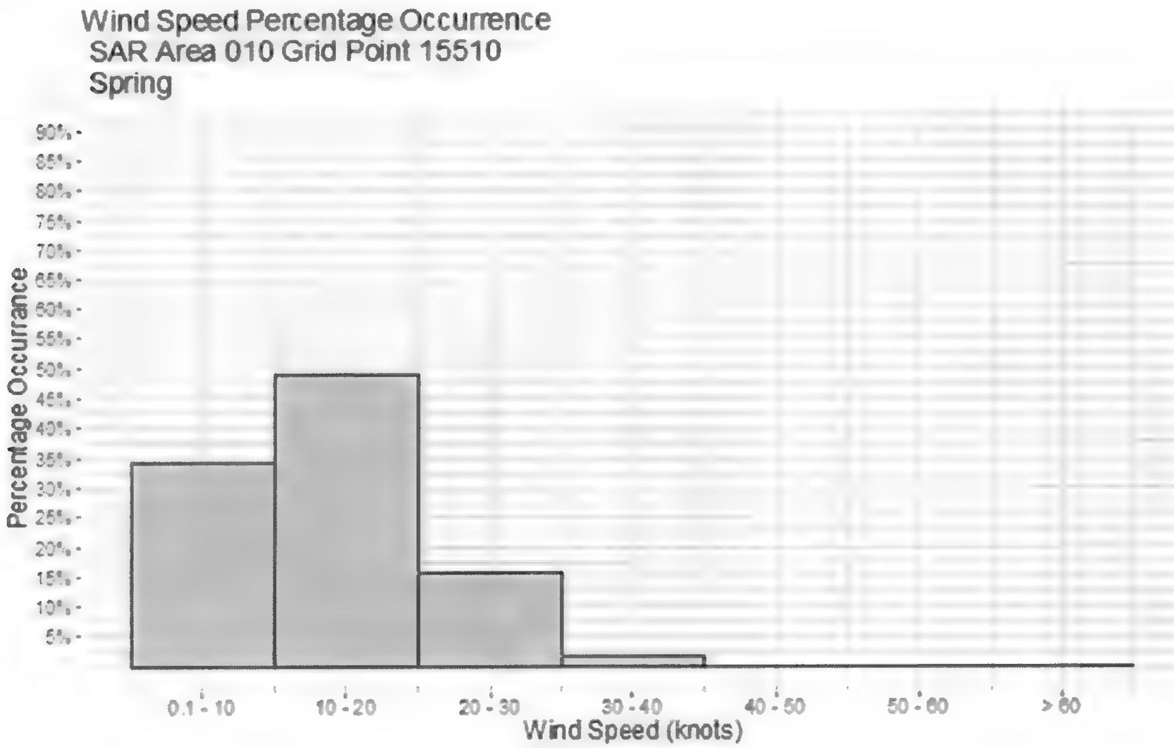

Figure 3.8 SAR Area 010 Spring Wind Speed Percentage Occurrence (Grid Point 15510)

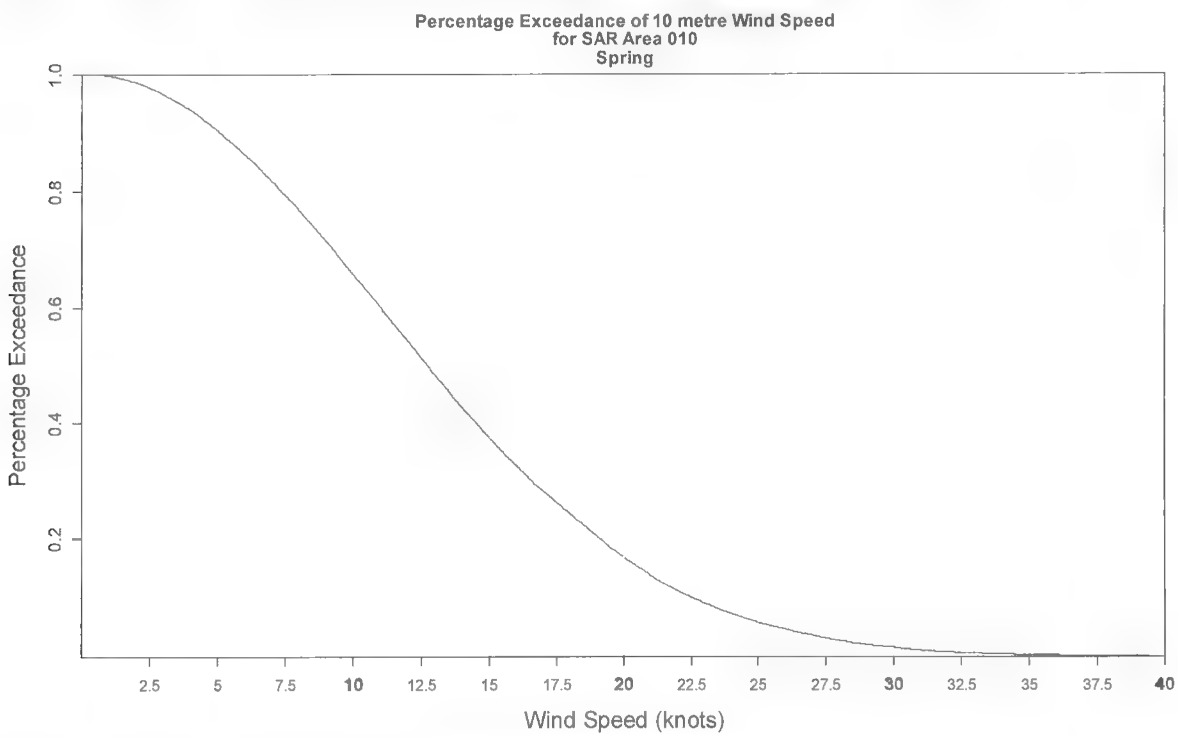

Figure 3.9 SAR Area 010 Spring Wind Speed Percentage Exceedance (Grid Point 15510)

Table 3.6 SAR Area 010 Summer Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 15510)

Source: MSC50 Total Samples: 21953

Wind Speed (knots)	Wind Direction (true / from)																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	2.77	3.25	2.85	2.93	3.38	3.66	3.27	2.82	2.56	2.60	3.12	3.87	4.80	5.71	5.02	3.99	57.16
10 - 20	2.15	1.97	1.46	1.77	2.64	3.38	3.03	1.72	1.25	1.29	1.67	2.42	3.22	3.64	3.45	3.28	38.66
20 - 30	0.16	0.28	0.19	0.23	0.55	0.68	0.36	0.16	0.04	0.04	0.12	0.20	0.31	0.23	0.28	0.26	4.12
30 - 40	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.06
40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

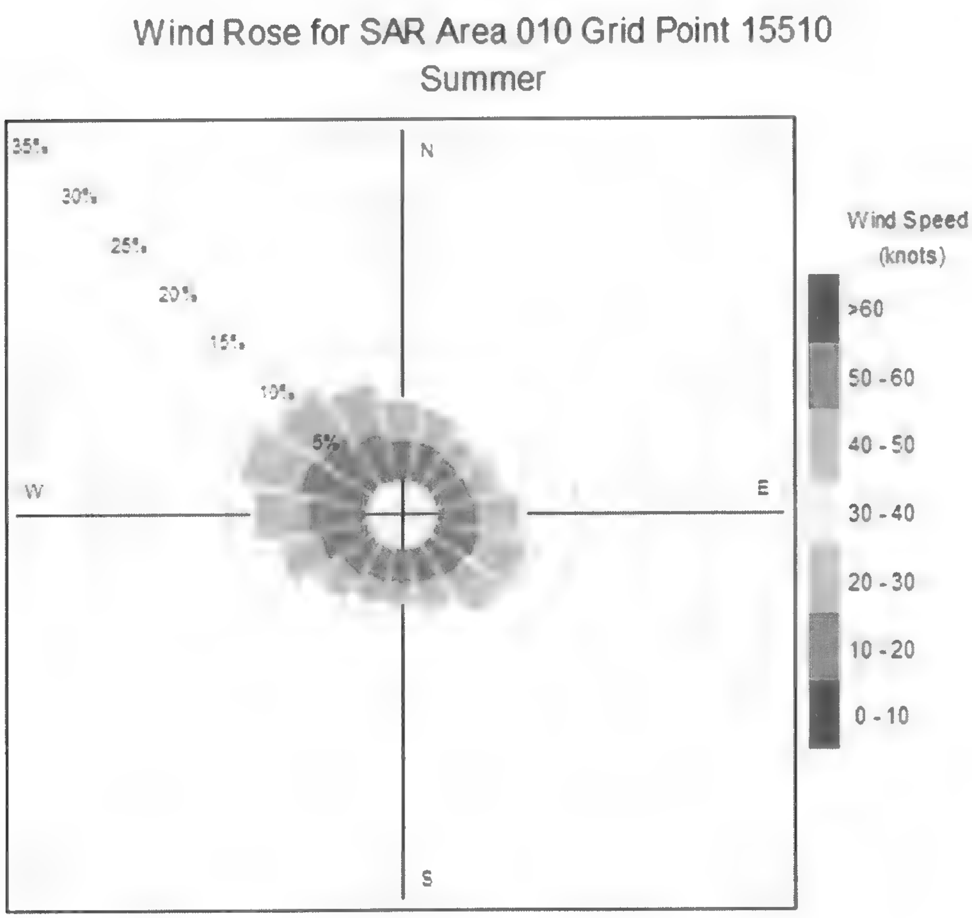

Figure 3.10 SAR Area 010 Summer Wind Rose Diagram (Grid Point 15510)

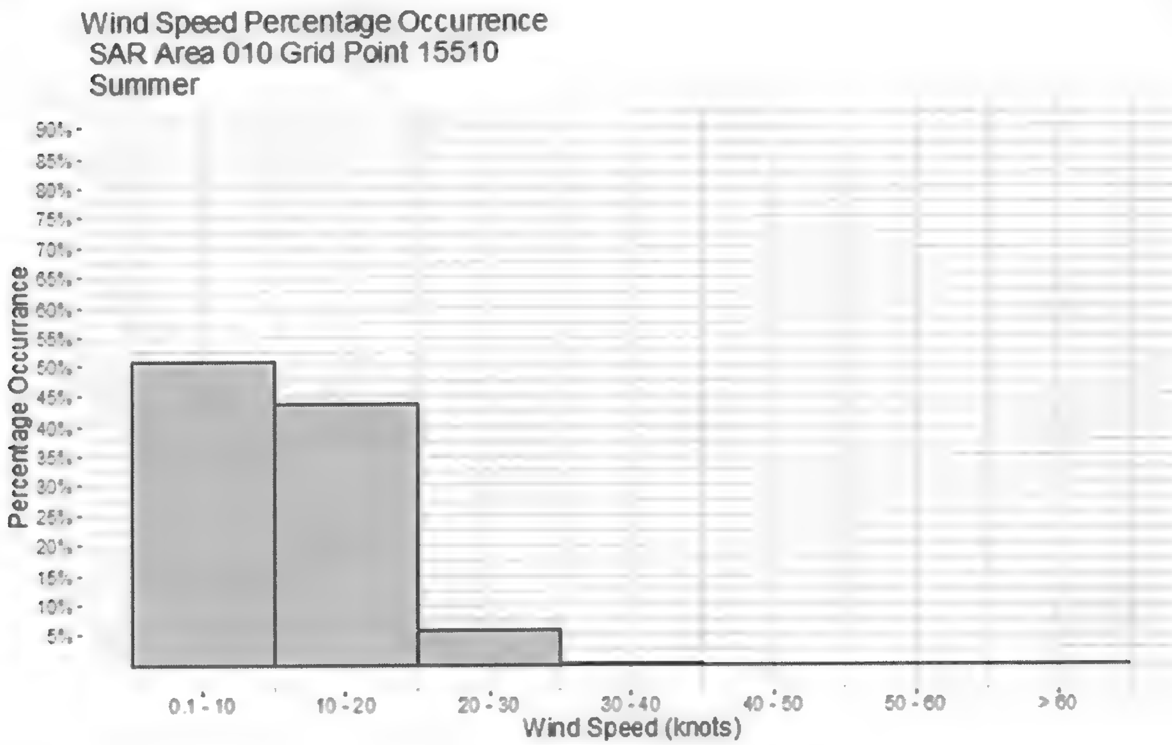

Figure 3.11 SAR Area 010 Summer Wind Speed Percentage Occurrence (Grid Point 15510)

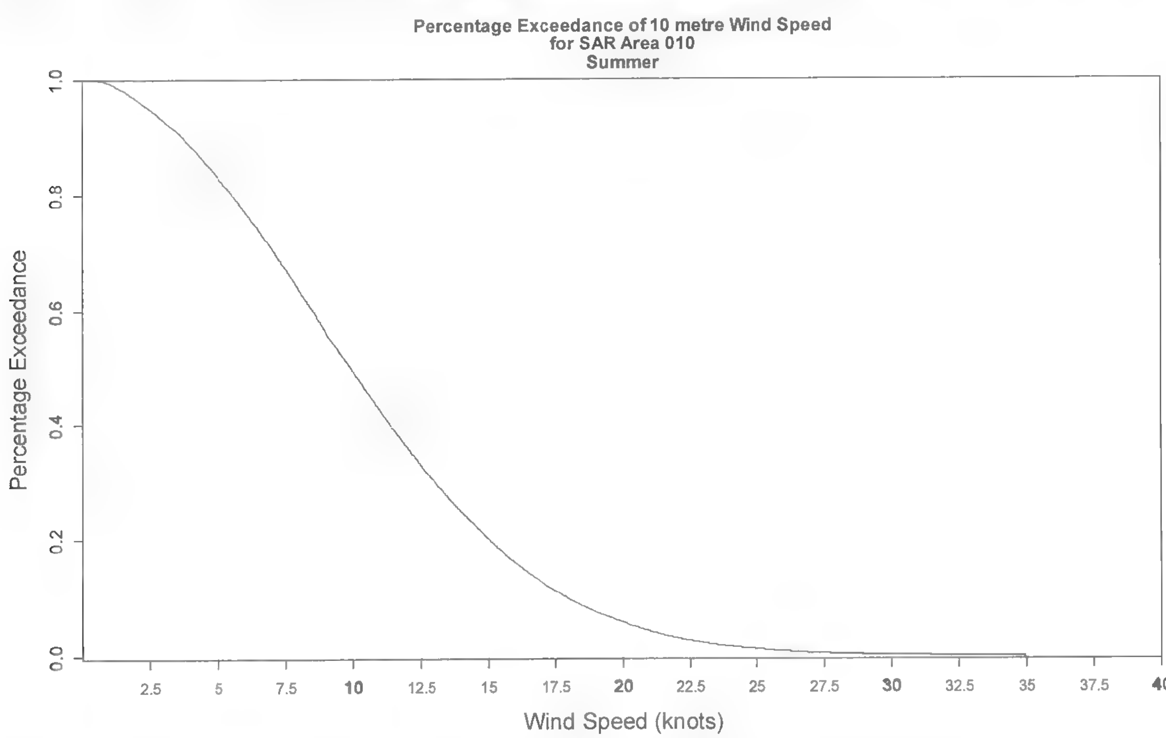

Figure 3.12 SAR Area 010 Summer Wind Speed Percentage Exceedance (Grid Point 15510)

Table 3.7 SAR Area 010 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 15510)

Source: MSC50 Total Samples: 21837

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	1.36	1.60	1.32	1.37	1.47	1.40	1.34	1.14	1.10	1.21	1.20	1.20	1.58	2.14	1.75	1.60	23.00
	10 - 20	2.79	2.56	2.11	2.18	2.27	2.61	2.23	2.10	1.96	1.78	2.18	2.81	4.10	5.53	6.92	5.89	50.73
	20 - 30	0.98	1.09	0.93	0.80	0.93	1.26	0.88	0.61	0.35	0.38	0.75	1.18	1.51	2.50	4.30	3.36	22.66
	30 - 40	0.20	0.27	0.23	0.15	0.27	0.19	0.08	0.04	0.05	0.04	0.05	0.06	0.20	0.36	0.56	0.55	3.50
	40 - 50	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.05	0.11
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

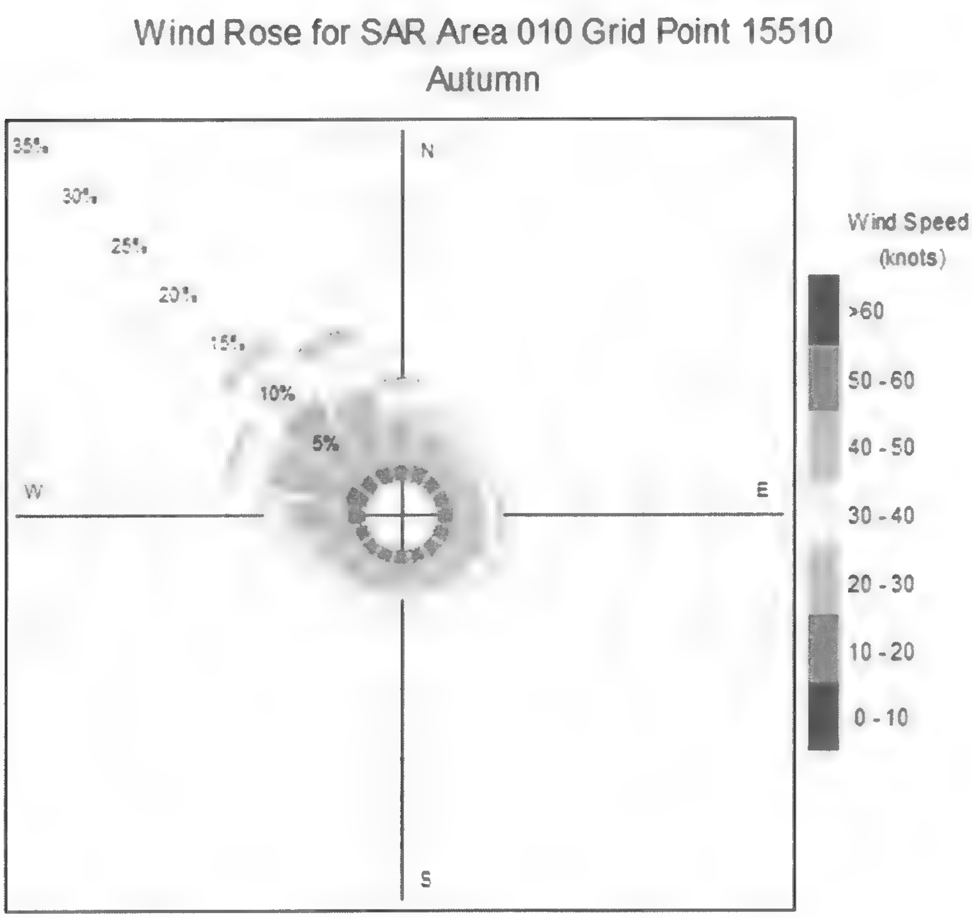

Figure 3.13 SAR Area 010 Autumn Wind Rose Diagram (Grid Point 15510)

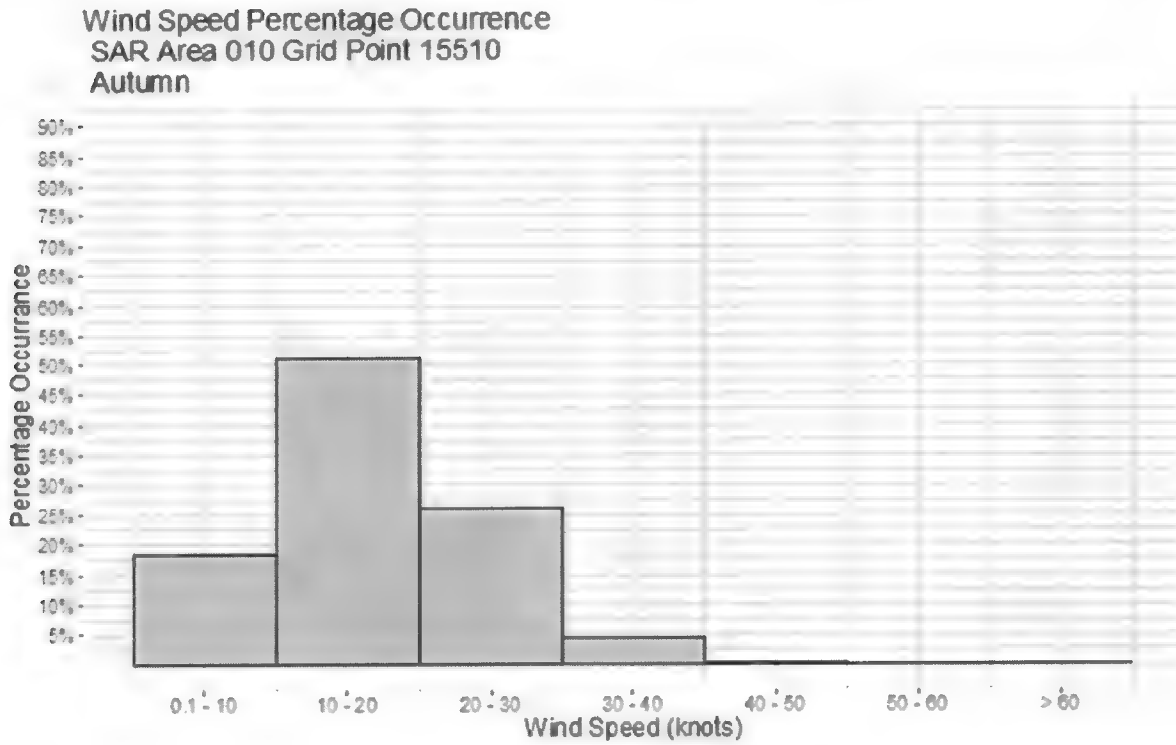

Figure 3.14 SAR Area 010 Autumn Wind Speed Percentage Occurrence (Grid Point 15510)

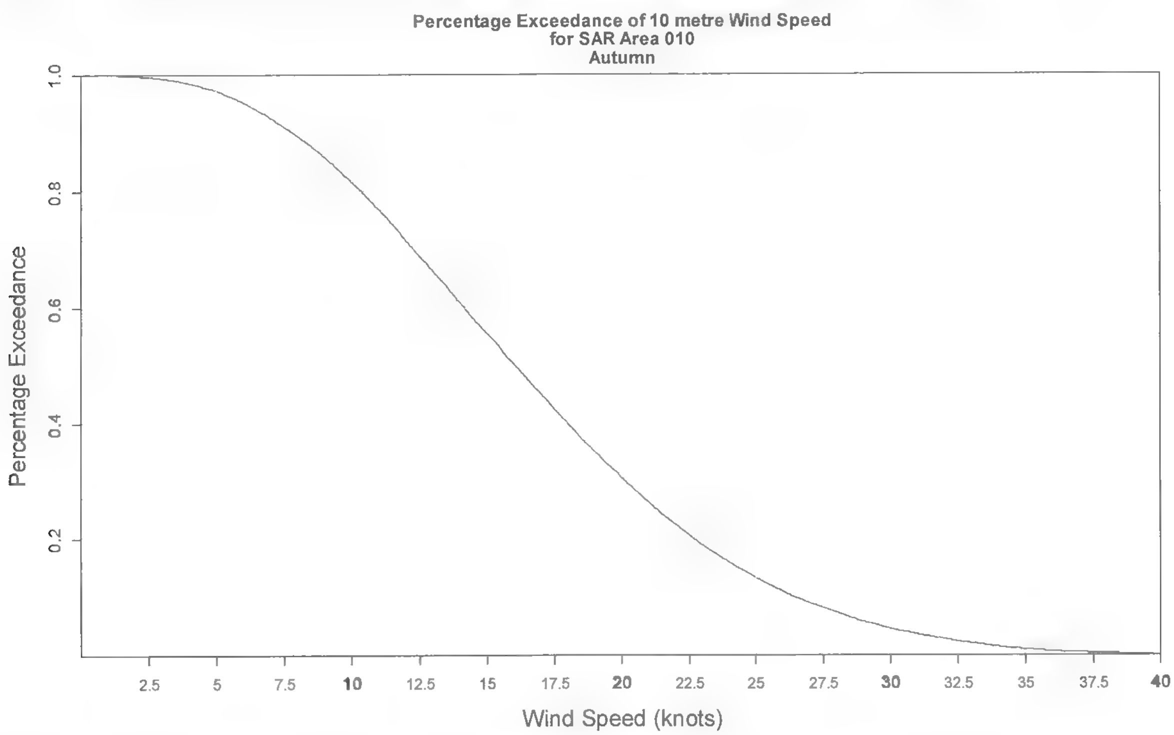

Figure 3.15 SAR Area 010 Autumn Wind Speed Percentage Exceedance (Grid Point 15510)

3.1.2 Wave Height

Significant Wave Height

Seasonal mean, standard deviation, mean maximum and absolute maximum significant wave height statistics are provided in Table 3.8 and Table 3.9 for SAR Area 010.

Tables depicting the joint percentage frequency distribution of significant wave height and direction are provided in Table 3.10 through Table 3.13. From these tables it can be seen that the predominant significant wave height during winter is between 1.0 and 2.0 metres from the northwest. Throughout the remainder of the year, the predominate significant wave height is 1.0 – 2.0 metres from the southeast.

Wave roses of the seasonal significant wave height and direction, the associated histogram of the significant wave height frequency and the significant wave height percentage exceedance are presented in Figure 3.16 through Figure 3.27. The wave roses are in meteorological convention and depict the direction the waves are coming from.

Table 3.8 SAR Area 010 Seasonal Significant Wave Height Statistics from MSC50 Grid Point 15510 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.8	1.6	7.6	12.2
Spring	0.8	1.1	3.8	12.0
Summer	1.3	0.7	4.1	5.6
Autumn	2.3	1.2	6.9	10.0

Table 3.9 SAR Area 010 Seasonal Significant Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.8	2.0	4.9	11.0
Spring	1.7	1.1	3.0	5.7
Summer	1.1	0.8	3.7	4.5
Autumn	1.7	1.2	5.9	7.2

Table 3.10 SAR Area 010 Winter Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 15510)

Source: MSC50 — Total Samples: 16002

	Wave Direction (true / from)																
Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	0.56	0.68	0.47	0.34	0.32	0.18	0.47	0.49	0.41	0.56	0.43	0.44	0.71	0.50	0.64	0.56	7.77
1.0 - 2.0	3.29	2.71	1.54	1.11	1.32	1.72	1.89	1.35	0.94	1.07	1.63	1.96	3.32	3.47	3.72	3.10	34.15
2.0 - 3.0	3.17	2.38	1.59	1.04	1.54	1.92	2.11	1.18	0.62	0.54	0.97	1.57	2.43	3.17	2.89	2.79	29.93
3.0 - 4.0	2.17	1.51	1.08	0.75	0.83	0.91	1.15	0.46	0.23	0.20	0.40	0.71	0.75	1.19	1.47	1.84	15.65
4.0 - 5.0	0.88	0.92	0.48	0.38	0.49	1.00	0.80	0.22	0.11	0.08	0.07	0.17	0.22	0.30	0.52	0.68	7.34
5.0 - 6.0	0.54	0.31	0.15	0.17	0.26	0.47	0.37	0.18	0.04	0.06	0.05	0.06	0.09	0.02	0.11	0.10	2.99
6.0 - 7.0	0.23	0.07	0.01	0.07	0.15	0.28	0.21	0.00	0.01	0.00	0.01	0.04	0.02	0.01	0.09	0.13	1.33
7.0 - 8.0	0.02	0.03	0.01	0.02	0.07	0.22	0.07	0.01	0.01	0.00	0.00	0.00	0.04	0.02	0.01	0.01	0.55
>= 8.0	0.00	0.00	0.00	0.02	0.03	0.17	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.29

Significant Wave Rose for SAR Area 010
Winter

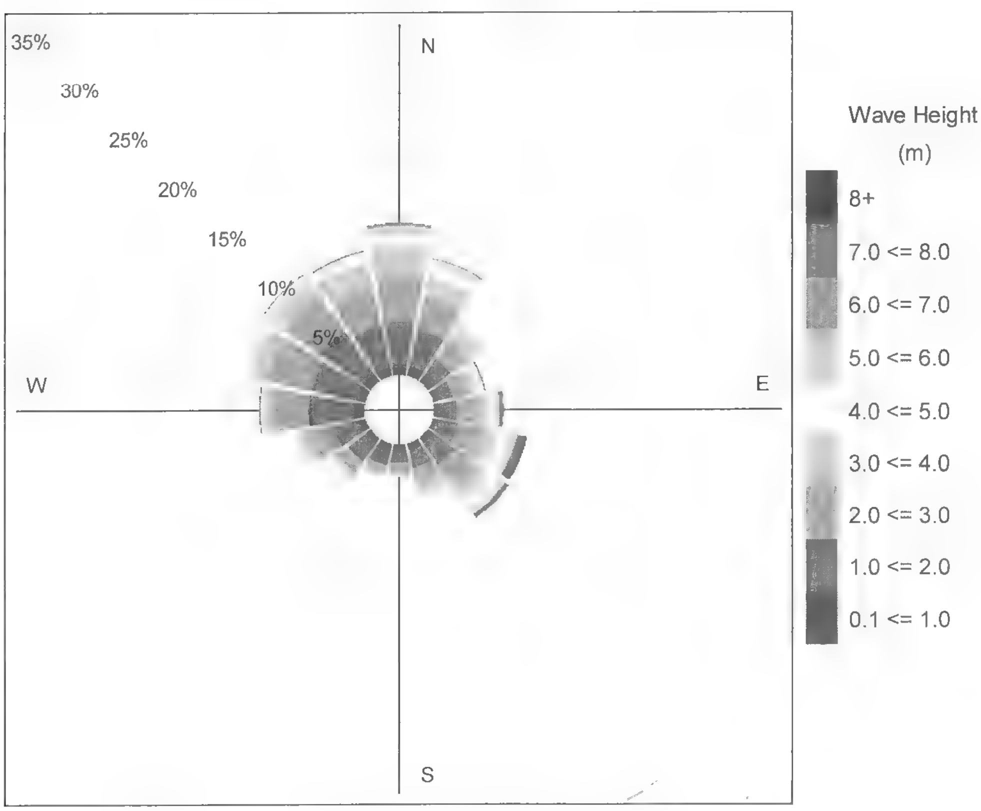

Figure 3.16 SAR Area 010 Winter Significant Wave Rose (Grid Point 15510)

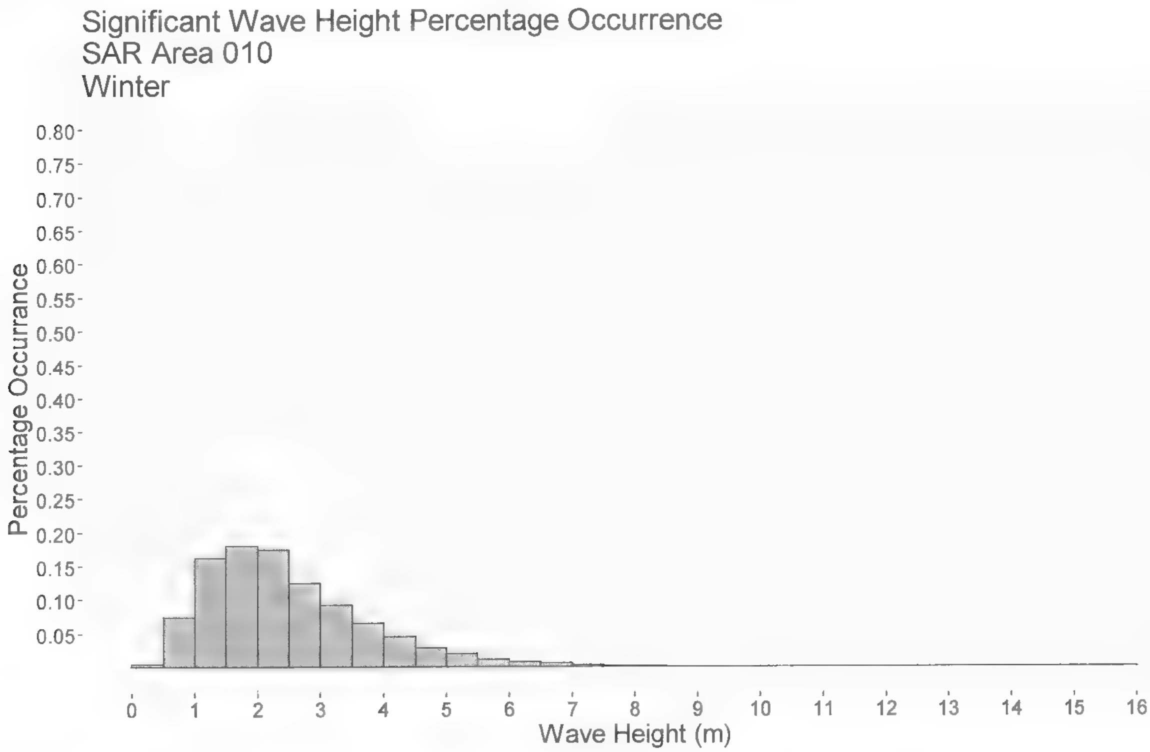

Figure 3.17 SAR Area 010 Winter Significant Wave Height Percentage Occurrence (Grid Point 15510)

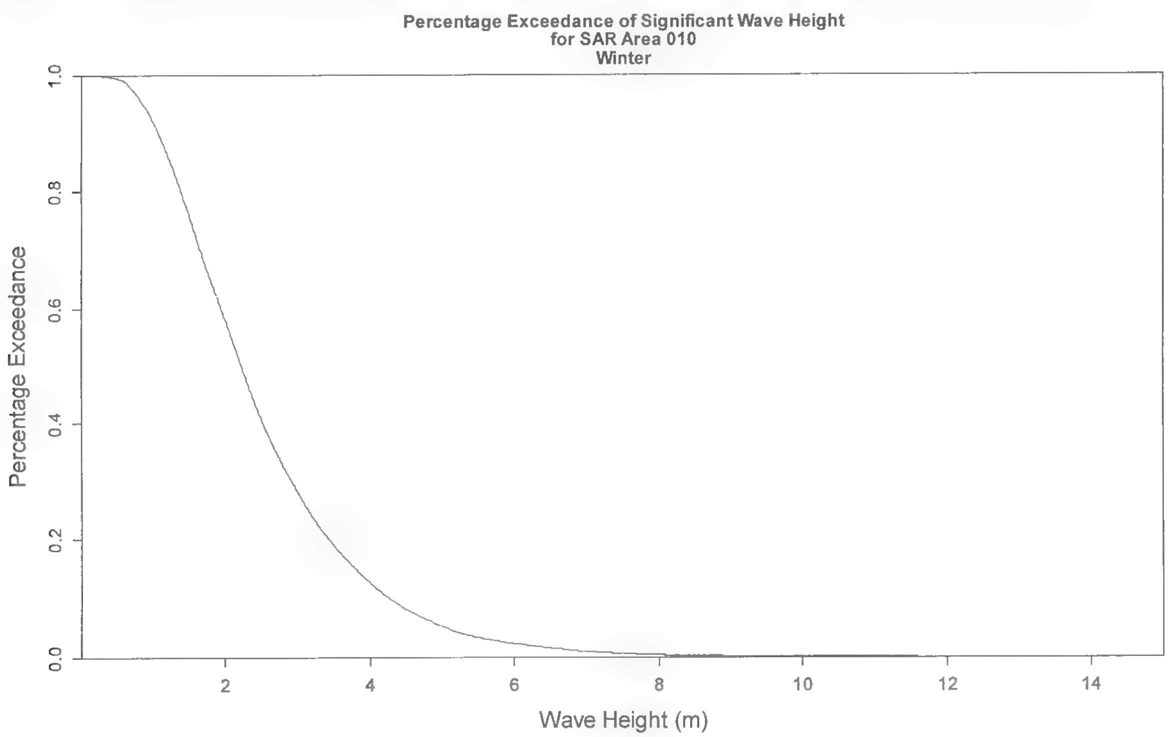

Figure 3.18 SAR Area 010 Winter Significant Wave Height Percentage Exceedance (Grid Point 15510)

Table 3.11 SAR Area 010 Spring Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 15510)

Source: MSC50 Total Samples: 10805

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	1.28	1.54	1.68	2.10	1.90	3.04	4.71	1.25	0.81	0.63	0.46	0.60	0.79	1.27	1.60	1.17	24.83
	1.0 - 2.0	3.12	3.17	2.93	2.21	2.69	6.27	7.28	3.26	1.47	0.91	0.98	1.27	2.42	2.75	3.54	2.67	46.97
	2.0 - 3.0	1.68	2.46	1.45	0.78	0.84	2.73	2.39	0.79	0.43	0.38	0.44	0.63	0.81	0.88	0.98	1.30	18.97
	3.0 - 4.0	0.53	0.75	0.59	0.35	0.42	1.22	0.69	0.27	0.10	0.03	0.06	0.16	0.20	0.15	0.34	0.29	6.15
	4.0 - 5.0	0.33	0.50	0.15	0.07	0.17	0.54	0.35	0.02	0.01	0.00	0.02	0.01	0.00	0.03	0.02	0.07	2.29
	5.0 - 6.0	0.01	0.07	0.02	0.01	0.05	0.21	0.12	0.01	0.00	0.00	0.06	0.00	0.00	0.00	0.04	0.02	0.62
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.01	0.13	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.17
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

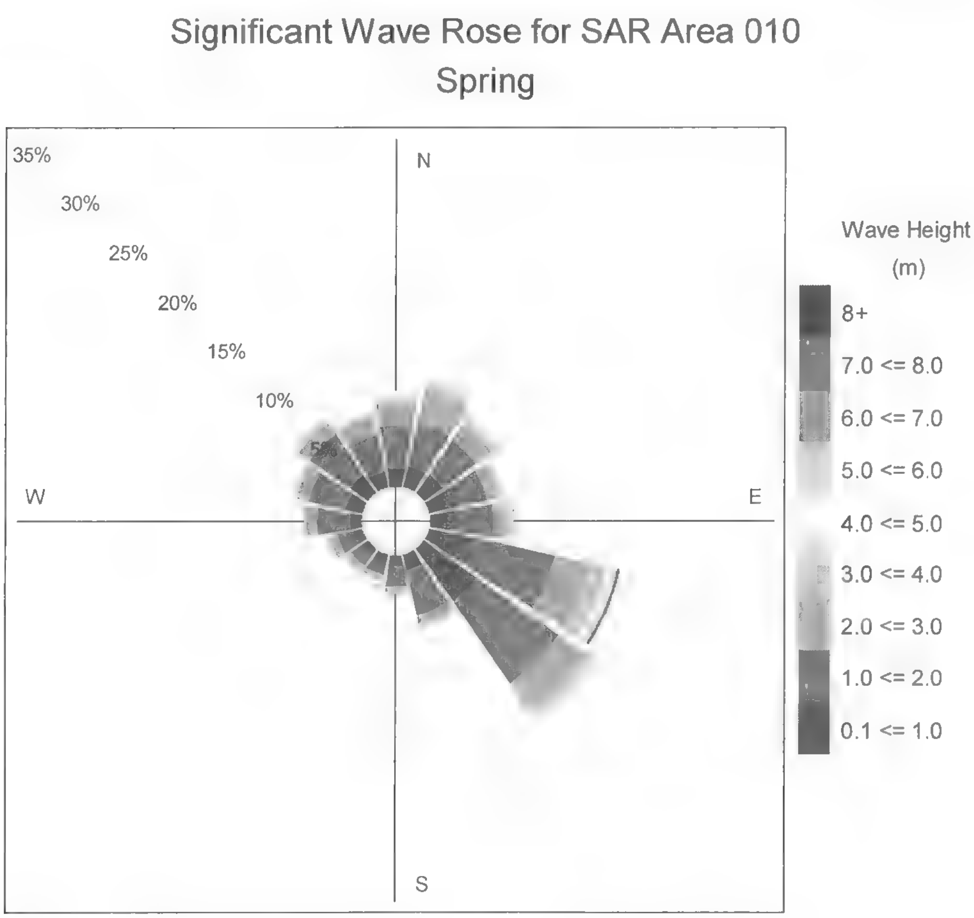

Figure 3.19 SAR Area 010 Spring Significant Wave Rose Diagram (Grid Point 15510)

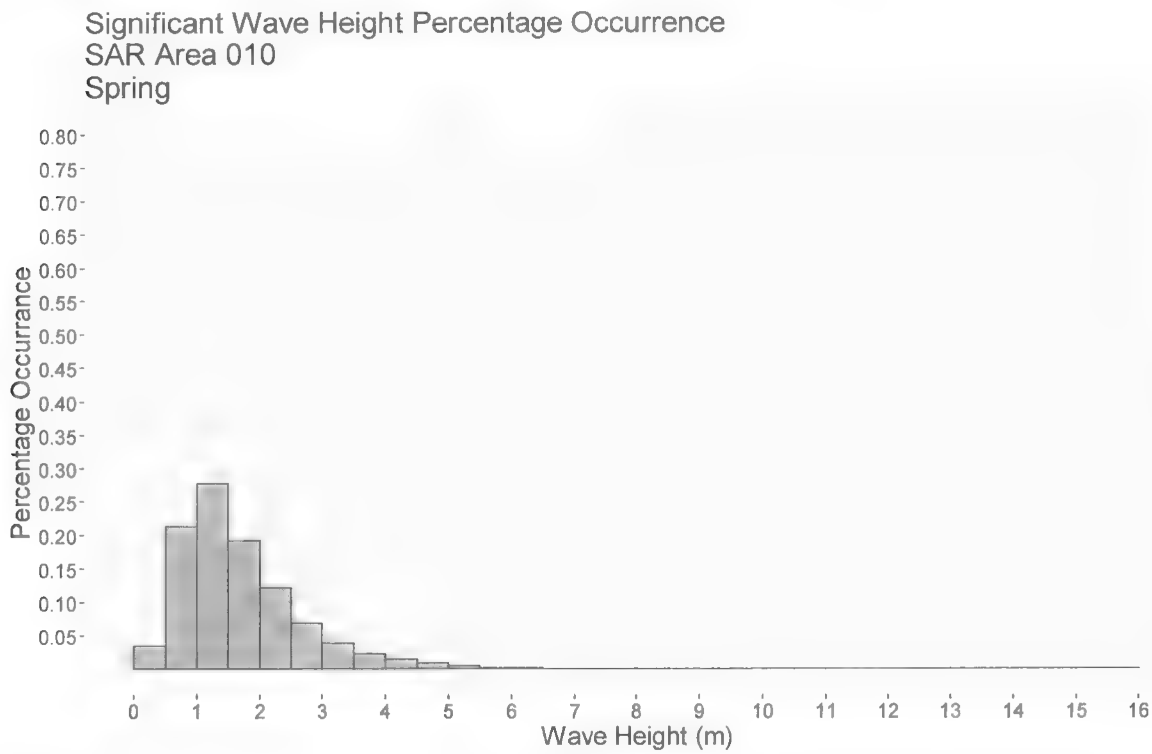

Figure 3.20 SAR Area 010 Spring Significant Wave Height Percentage Occurrence (Grid Point 15510)

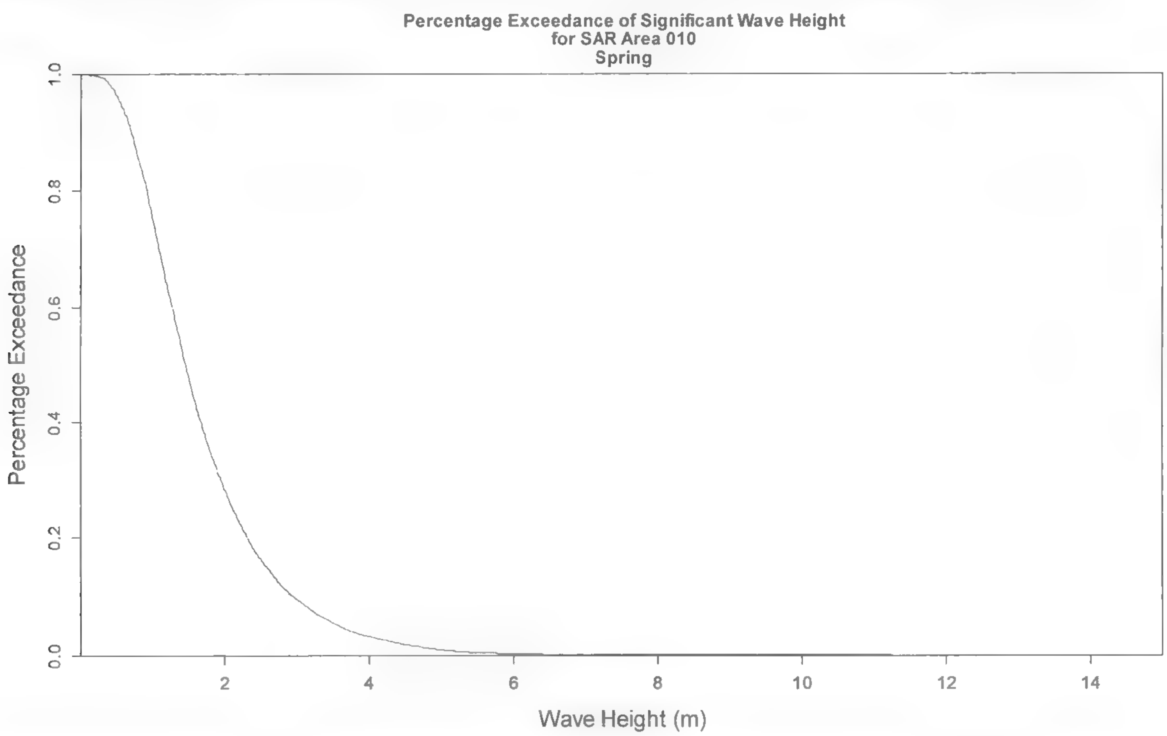

Figure 3.21 SAR Area 010 Spring Significant Wave Height Percentage Exceedance (Grid Point 15510)

Table 3.12 SAR Area 010 Summer Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 15510)

Source: MSC50 | Total Samples: 21593

Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
	Wave Direction (true / from)																
0.0 - 1.0	0.90	1.63	1.68	1.30	2.38	6.49	10.11	4.12	1.21	0.82	0.75	0.71	0.82	0.88	0.72	0.86	35.37
1.0 - 2.0	2.07	2.25	1.75	2.11	3.05	9.60	11.73	4.58	2.16	1.63	1.56	1.90	2.13	1.49	1.39	1.49	50.89
2.0 - 3.0	0.58	0.43	0.34	0.54	0.85	3.03	1.79	0.64	0.31	0.25	0.30	0.33	0.53	0.31	0.20	0.29	10.73
3.0 - 4.0	0.06	0.10	0.13	0.14	0.33	0.90	0.41	0.06	0.02	0.00	0.03	0.11	0.09	0.05	0.03	0.09	2.57
4.0 - 5.0	0.00	0.00	0.00	0.00	0.04	0.19	0.06	0.02	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.38
5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Significant Wave Rose for SAR Area 010
Summer

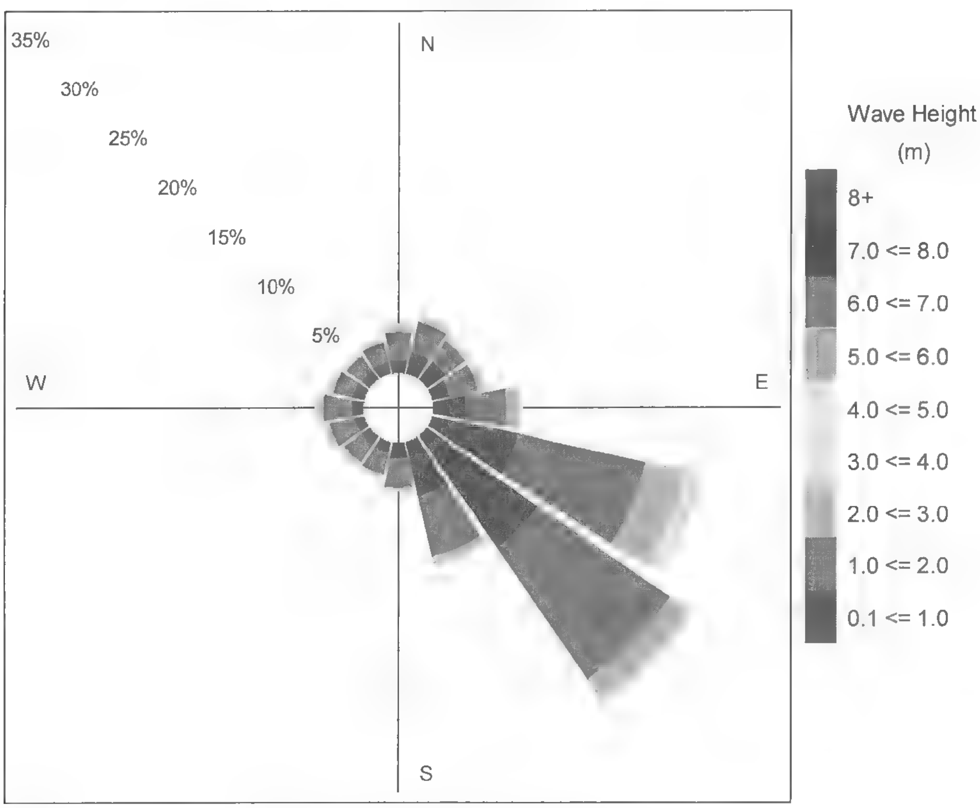

Figure 3.22 SAR Area 010 Summer Significant Wave Rose Diagram (Grid Point 15510)

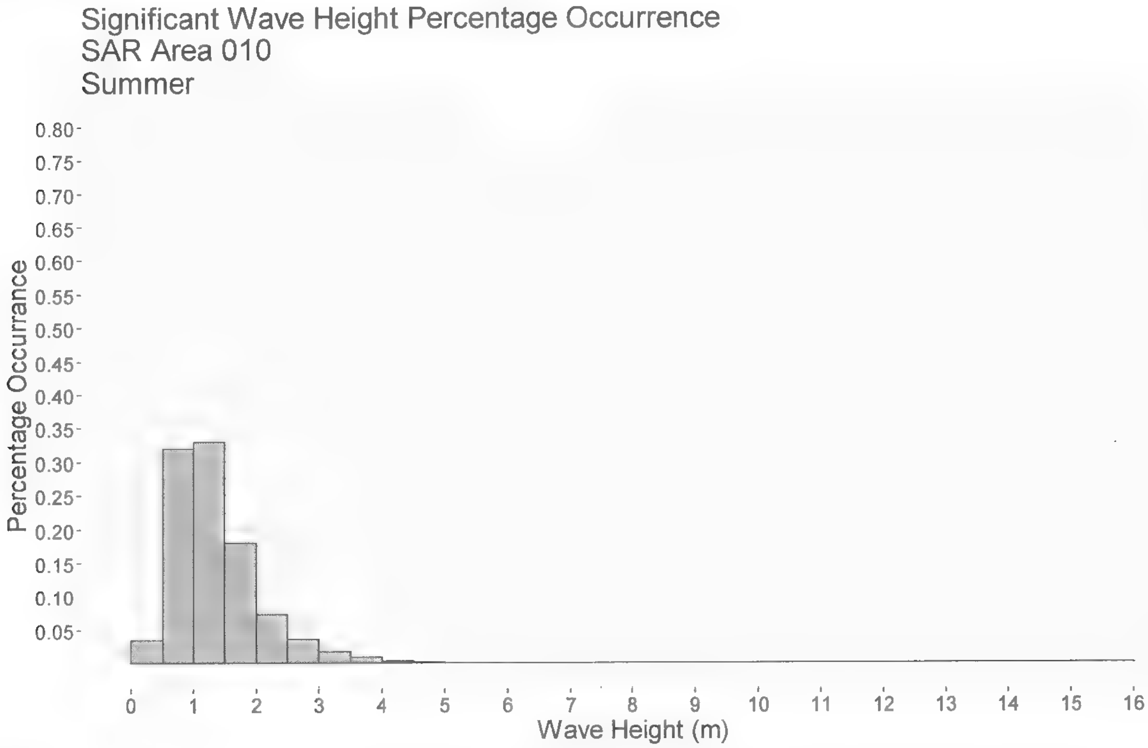

Figure 3.23 SAR Area 010 Summer Significant Wave Height Percentage Occurrence (Grid Point 15510)

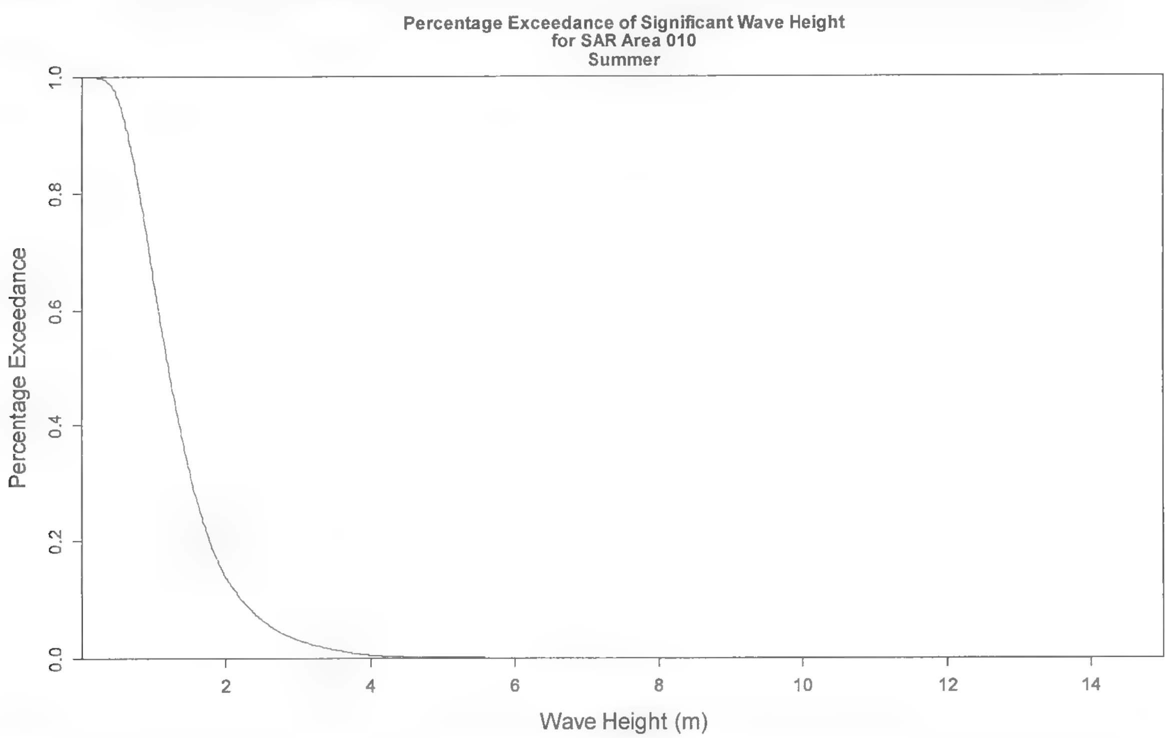

Figure 3.24 SAR Area 010 Summer Significant Wave Height Percentage Exceedance (Grid Point 15510)

Table 3.13 SAR Area 010 Autumn Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 15510)

Source: MSC50 Total Samples: 21840

	Wave Direction (true / from)																
Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	0.71	0.59	0.50	0.29	0.31	0.43	0.81	0.38	0.29	0.35	0.25	0.32	0.27	0.33	0.48	0.54	6.87
1.0 - 2.0	3.84	3.36	2.15	1.90	2.09	3.32	3.98	3.00	2.07	1.47	1.66	1.90	2.17	2.16	2.71	3.61	41.42
2.0 - 3.0	3.33	1.76	1.24	1.16	1.67	2.70	2.09	1.79	1.05	0.76	0.90	1.21	1.49	1.96	2.78	3.41	29.30
3.0 - 4.0	1.76	0.91	0.66	0.51	0.69	1.47	0.88	0.51	0.26	0.36	0.52	0.65	0.74	0.86	1.34	1.47	13.58
4.0 - 5.0	0.86	0.33	0.27	0.23	0.35	0.60	0.37	0.15	0.09	0.10	0.16	0.22	0.21	0.27	0.45	0.69	5.35
5.0 - 6.0	0.37	0.24	0.14	0.09	0.21	0.24	0.13	0.05	0.03	0.02	0.05	0.06	0.14	0.10	0.15	0.27	2.28
6.0 - 7.0	0.09	0.11	0.02	0.02	0.07	0.15	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.02	0.05	0.08	0.74
7.0 - 8.0	0.02	0.01	0.00	0.00	0.02	0.13	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.33
>= 8.0	0.07	0.00	0.00	0.00	0.02	0.04	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.21

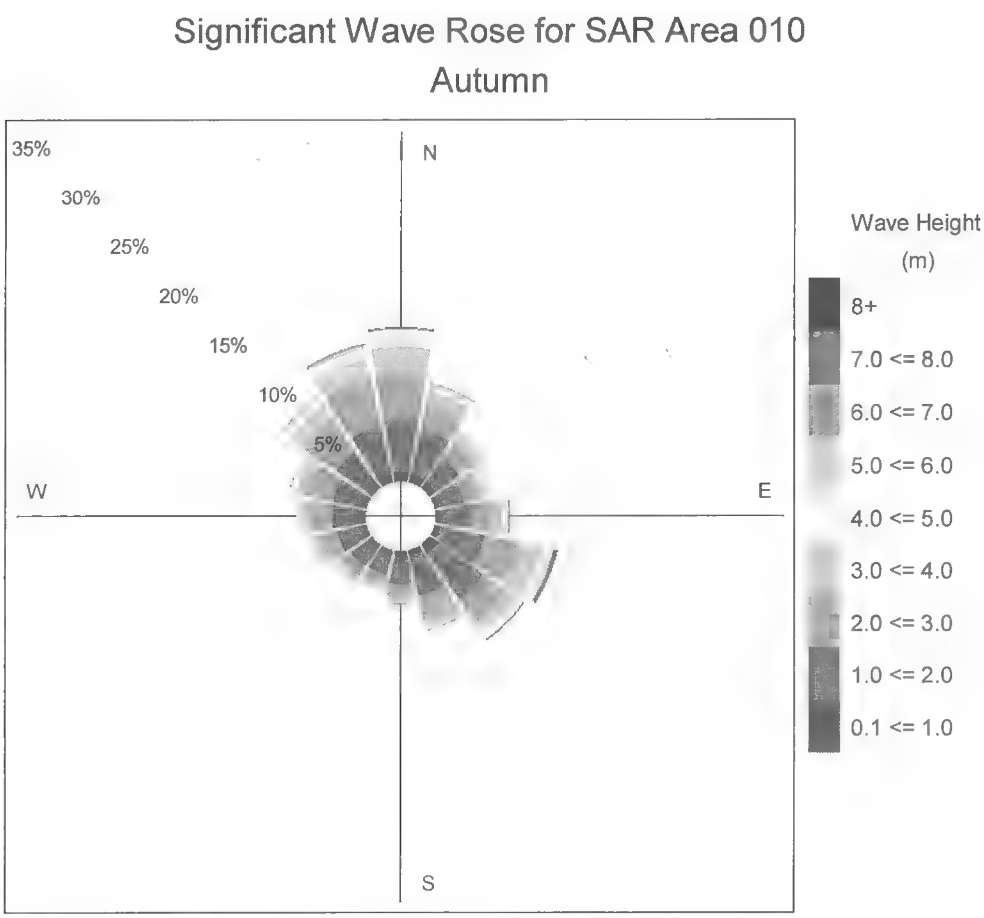

Figure 3.25 SAR Area 010 Autumn Significant Wave Rose Diagram (Grid Point 13408)

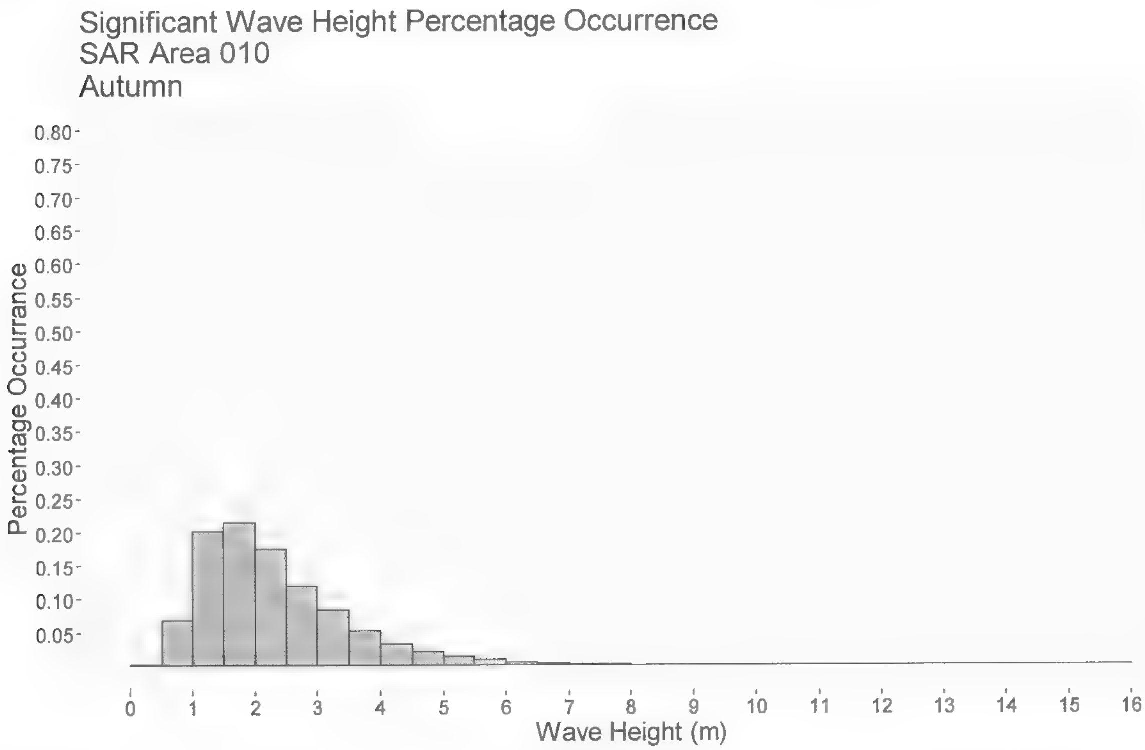

Figure 3.26 SAR Area 010 Autumn Significant Wave Height Percentage Occurrence (Grid Point 13408)

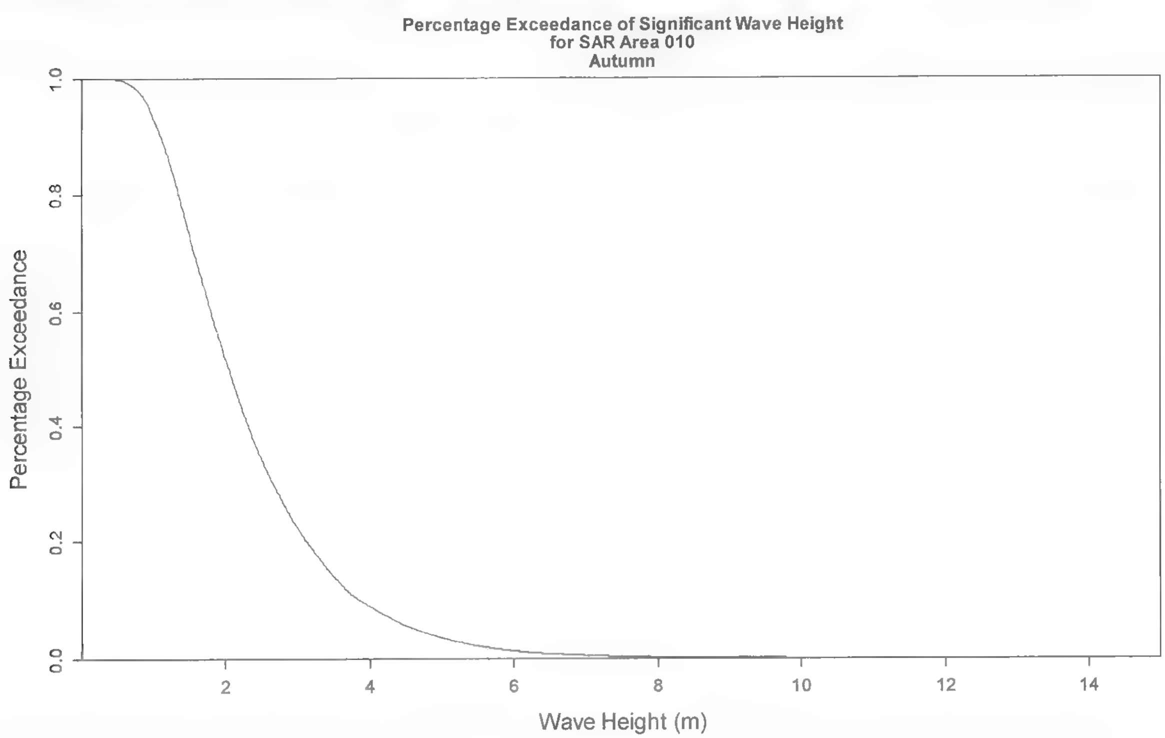

Figure 3.27 SAR Area 010 Autumn Significant Wave Height Percentage Exceedance (Grid Point 13408)

Wind Wave Height

Seasonal mean, standard deviation, mean maximum and absolute maximum wind wave height statistics are provided in Table 3.14 and Table 3.15 for SAR Area 010.

Tables depicting the joint percentage frequency distribution of wind wave height and direction are provided in Table 3.16 through Table 3.19. From these tables it can be seen that the predominant wind wave height during Autumn, Winter and Spring is between 1.0 and 2.0 metres from the northwest. During the summer months, the predominate wind wave height is 0.0 – 1.0 metres from the west-northwest.

Wave roses of the seasonal wind wave height and direction, the associated histogram of the wind wave height frequency and the wind wave height percentage exceedance are presented in Figure 3.28 through Figure 3.39.

The wave roses are in meteorological convention and depict the direction the waves are coming from.

Table 3.14 SAR Area 010 Seasonal Wind Wave Height Statistics from MSC50 Grid Point 13408 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.4	1.4	6.7	11.9
Spring	0.6	0.9	3.4	11.4
Summer	0.7	0.7	3.8	5.4
Autumn	1.1	1.2	7.4	11.9

Table 3.15 SAR Area 010 Seasonal Wind Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.0	1.4	3.5	6.0
Spring	1.4	0.9	2.5	5.0
Summer	0.9	0.5	2.7	3.0
Autumn	1.3	0.9	4.5	5.0

Table 3.16 SAR Area 010 Winter Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (Grid Point 13408)

Source: MSC50 | Total Samples: 15484

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	1.99	1.51	1.08	0.76	0.65	0.57	0.54	0.58	0.83	0.88	1.14	1.70	2.43	2.69	2.73	2.51	22.57
	1.0 - 2.0	3.63	2.05	1.03	0.95	0.74	0.72	0.69	0.55	0.49	0.64	1.22	2.56	4.38	5.80	6.34	4.70	36.49
	2.0 - 3.0	2.71	1.74	1.07	0.48	0.36	0.48	0.51	0.43	0.19	0.22	0.52	1.36	2.29	3.73	3.62	3.09	22.80
	3.0 - 4.0	1.47	1.36	0.53	0.37	0.28	0.37	0.21	0.22	0.15	0.08	0.16	0.62	0.77	1.38	1.76	1.85	11.57
	4.0 - 5.0	0.81	0.64	0.19	0.18	0.21	0.25	0.15	0.13	0.10	0.06	0.08	0.16	0.21	0.27	0.35	0.46	4.26
	5.0 - 6.0	0.26	0.10	0.08	0.10	0.14	0.12	0.11	0.05	0.00	0.01	0.01	0.06	0.07	0.05	0.20	0.17	1.53
	6.0 - 7.0	0.15	0.07	0.02	0.08	0.03	0.07	0.01	0.00	0.00	0.00	0.00	0.02	0.04	0.03	0.03	0.03	0.58
	7.0 - 8.0	0.01	0.00	0.01	0.00	0.03	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.01	0.19
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Wave Rose for SAR Area 010
Winter

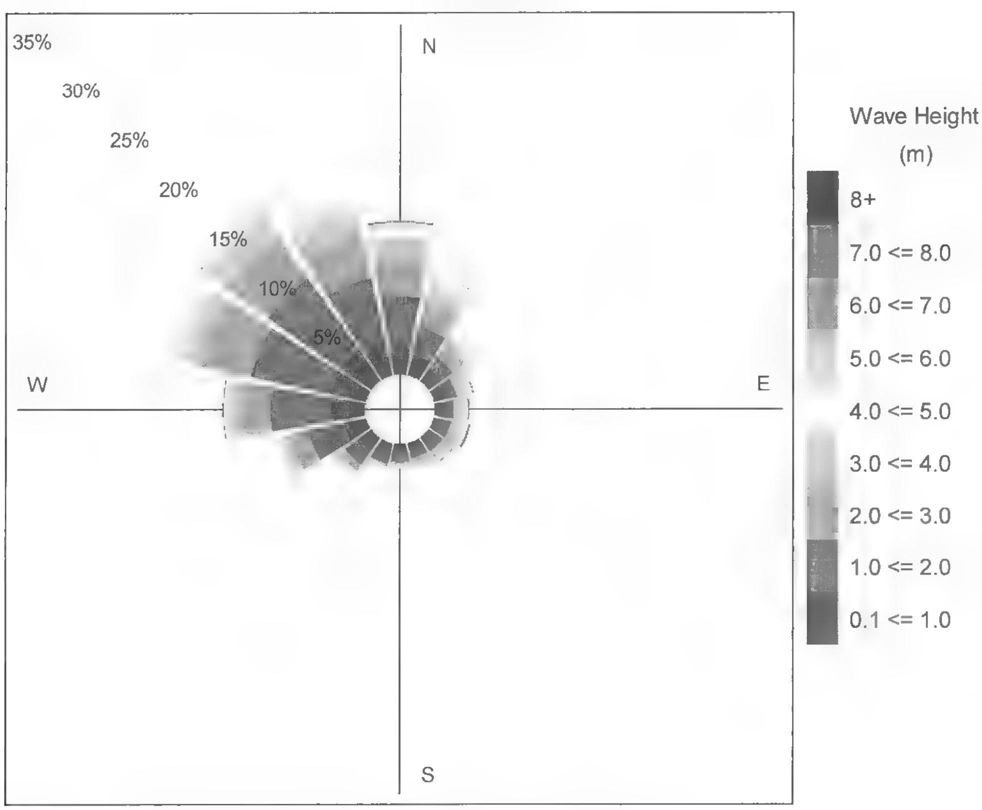

Figure 3.28 SAR Area 010 Winter Wind Wave Rose (Grid Point 13408)

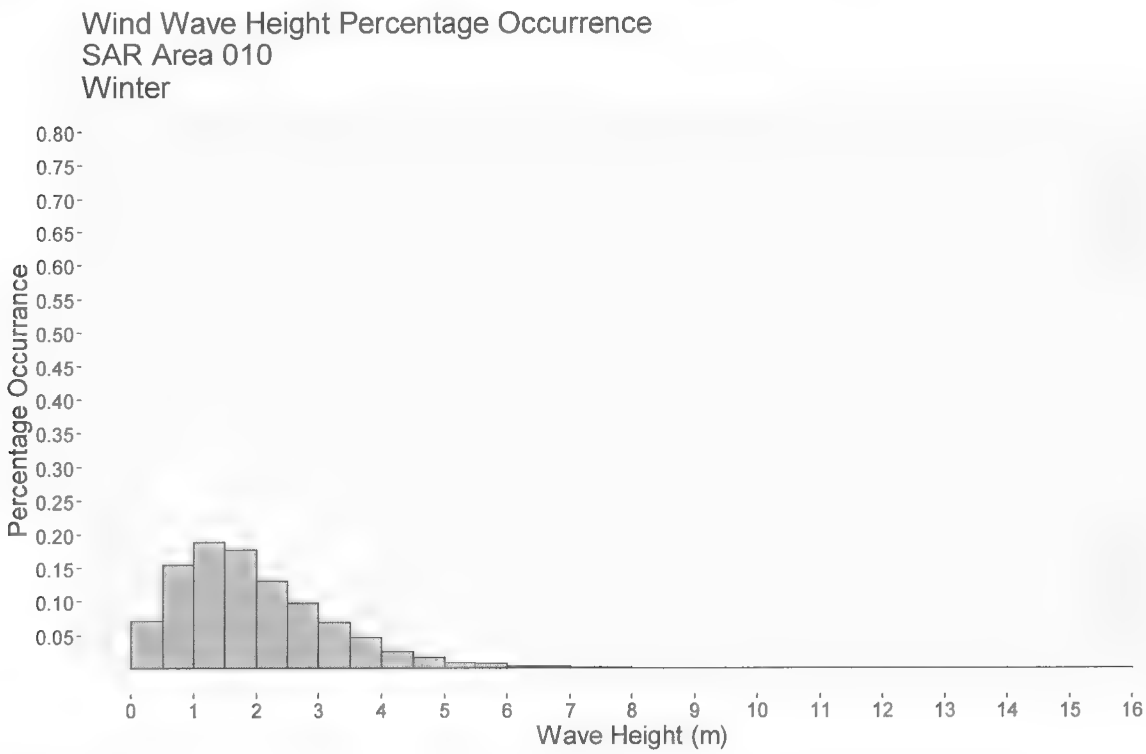

Figure 3.29 SAR Area 010 Winter Wind Wave Height Percentage Occurrence (Grid Point 13408)

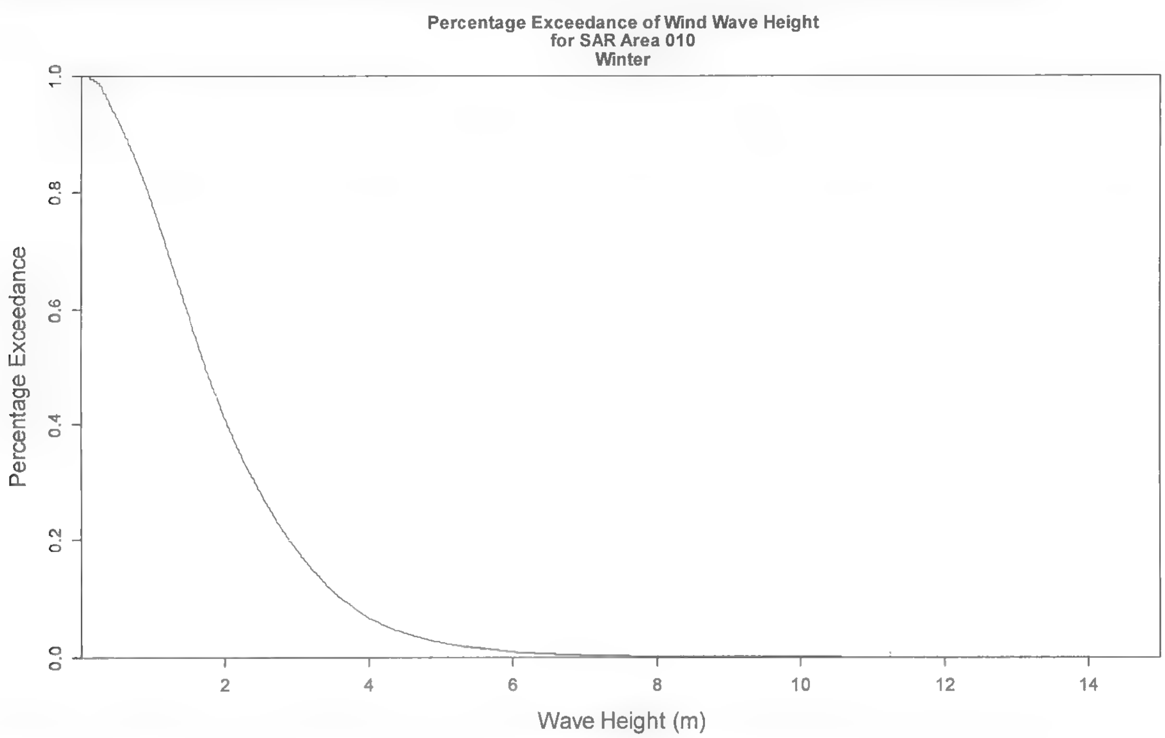

Figure 3.30 SAR Area 010 Winter Wind Wave Height Percentage Exceedance (Grid Point 13408)

Table 3.17 SAR Area 010 Spring Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (Grid Point 13408)

Source: MSC50 Total Samples: 9433

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	3.51	2.80	2.68	2.23	2.00	1.97	2.11	2.00	1.66	1.46	1.60	2.45	3.00	4.91	4.94	4.11	43.44
	1.0 - 2.0	4.47	2.57	1.61	1.21	1.14	1.74	1.63	1.96	0.77	0.84	0.90	1.60	3.12	4.52	5.46	4.47	38.02
	2.0 - 3.0	1.92	1.87	0.85	0.46	0.63	0.65	0.56	0.52	0.24	0.15	0.20	0.72	0.95	0.89	1.16	1.41	13.17
	3.0 - 4.0	0.67	0.72	0.17	0.08	0.11	0.24	0.22	0.11	0.06	0.00	0.02	0.14	0.18	0.18	0.42	0.40	3.73
	4.0 - 5.0	0.35	0.36	0.06	0.03	0.05	0.18	0.19	0.00	0.00	0.00	0.02	0.05	0.00	0.04	0.04	0.02	1.41
	5.0 - 6.0	0.00	0.04	0.00	0.00	0.01	0.07	0.02	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.03	0.00	0.23
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

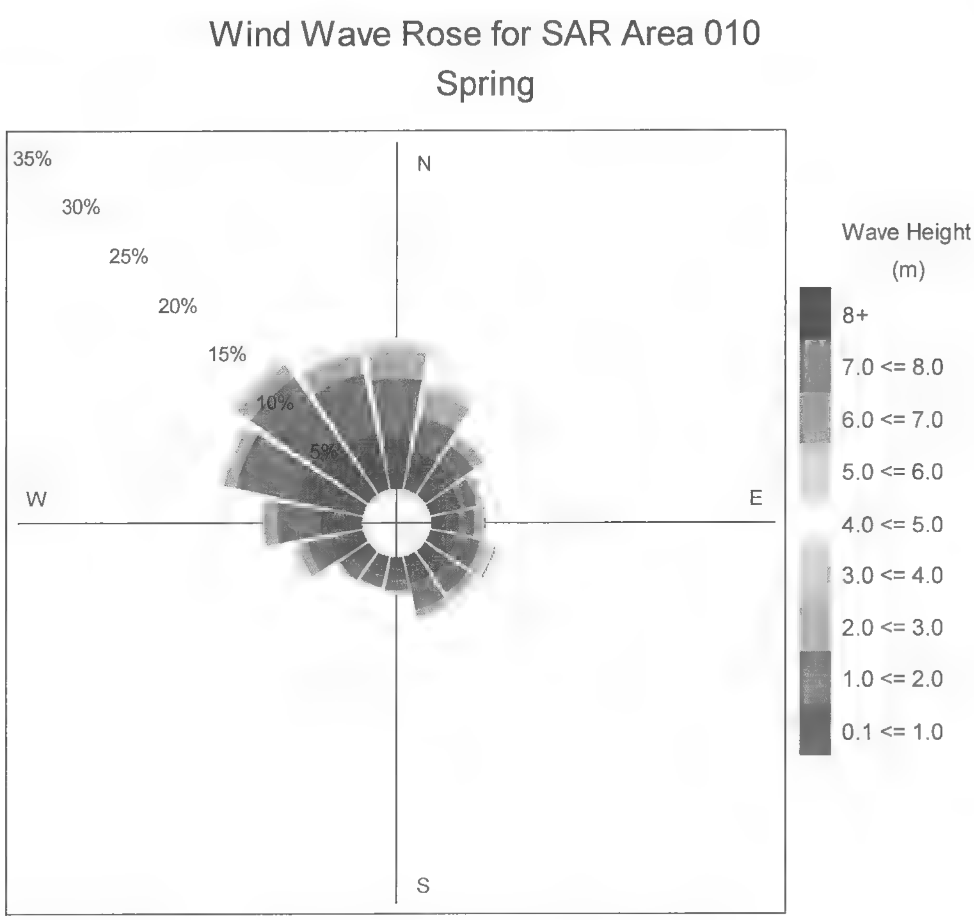

Figure 3.31 SAR Area 010 Spring Wind Wave Rose Diagram (Grid Point 13408)

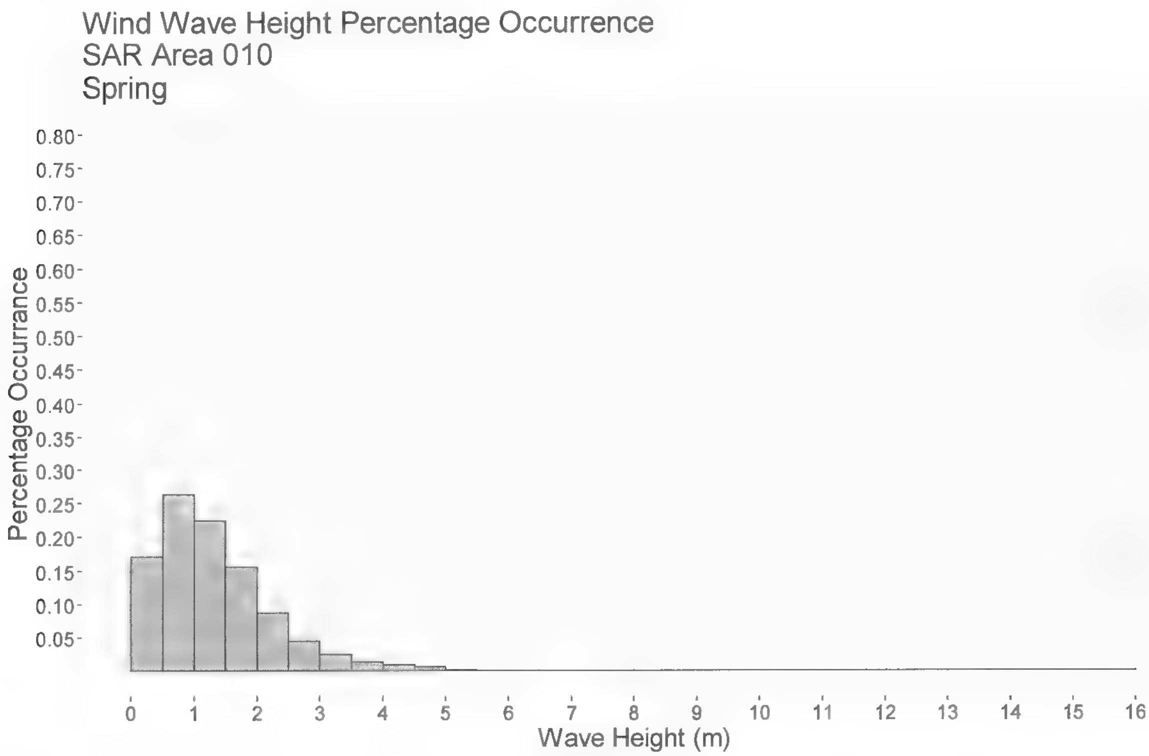

Figure 3.32 SAR Area 010 Spring Wind Wave Height Percentage Occurrence (Grid Point 13408)

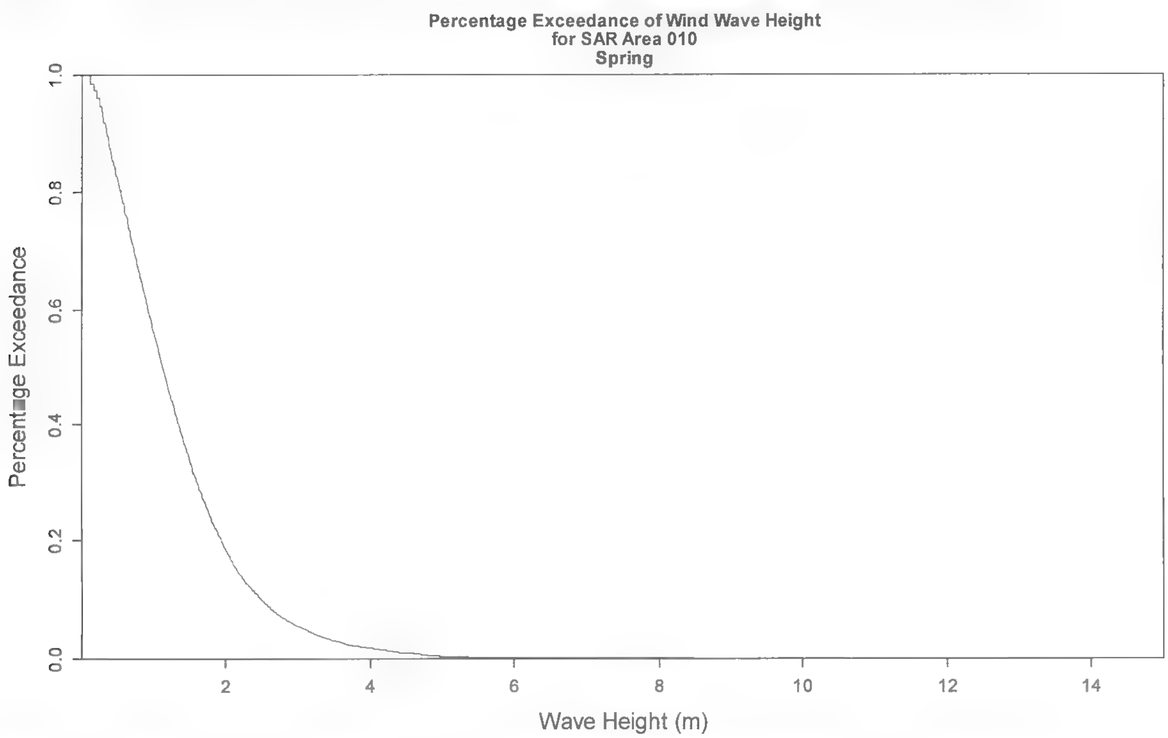

Figure 3.33 SAR Area 010 Spring Wind Wave Height Percentage Exceedance (Grid Point 13408)

Table 3.18 SAR Area 010 Summer Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (Grid Point 13408)

Source: MSC50 — Total Samples: 16443

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	4.11	3.71	3.11	3.20	3.44	4.11	4.06	3.21	2.52	2.56	3.20	3.55	4.82	5.61	4.66	4.32	60.18
	1.0 - 2.0	2.13	1.81	1.18	1.17	1.81	2.75	3.22	1.58	1.12	1.06	1.31	2.19	2.94	2.26	2.05	2.49	31.07
	2.0 - 3.0	0.51	0.33	0.36	0.39	0.58	1.17	1.03	0.36	0.14	0.09	0.18	0.34	0.55	0.38	0.30	0.35	7.07
	3.0 - 4.0	0.04	0.10	0.07	0.07	0.19	0.30	0.23	0.03	0.00	0.00	0.04	0.11	0.08	0.05	0.02	0.12	1.46
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.02	0.05	0.04	0.02	0.00	0.00	0.01	0.07	0.01	0.00	0.00	0.00	0.21
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

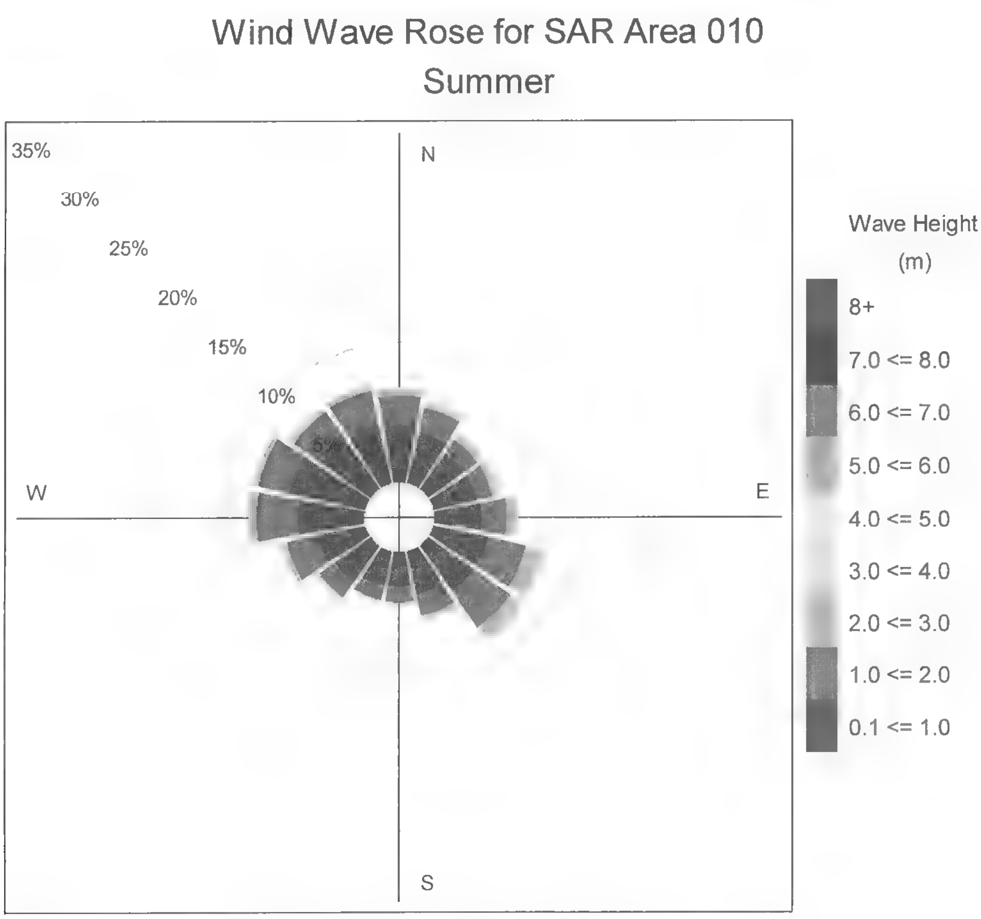

Figure 3.34 SAR Area 010 Summer Wind Wave Rose Diagram (Grid Point 13408)

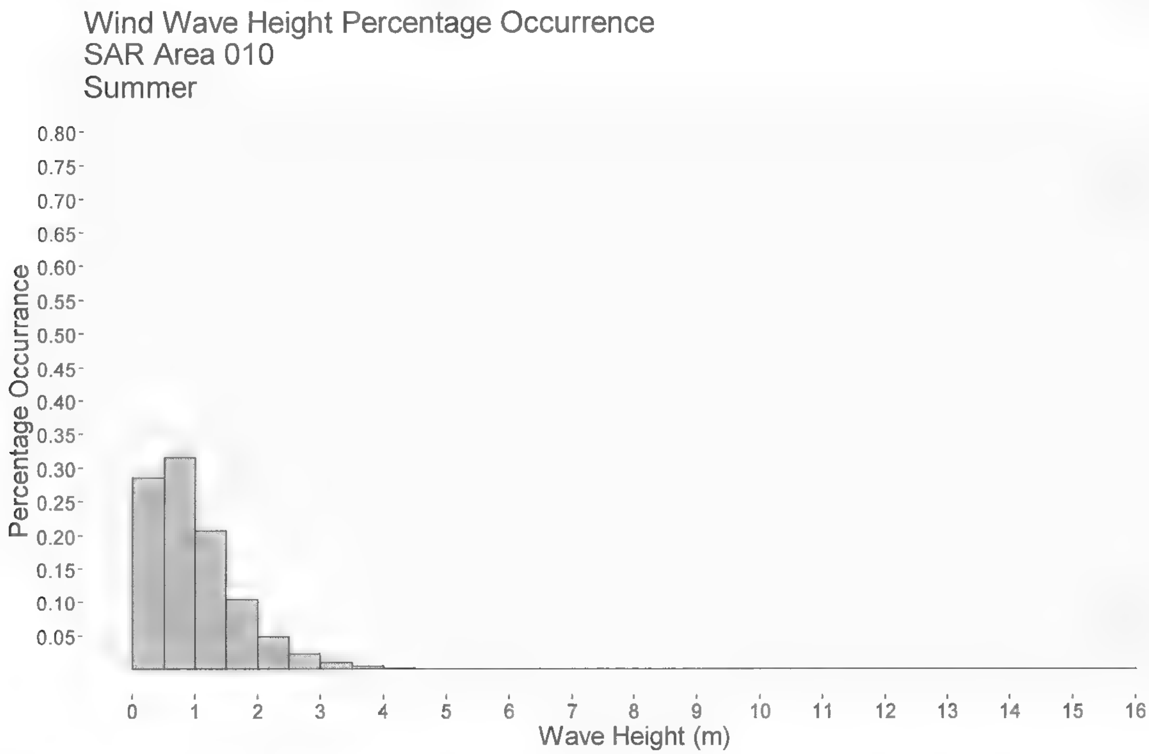

Figure 3.35 SAR Area 010 Summer Wind Wave Height Percentage Occurrence (Grid Point 13408)

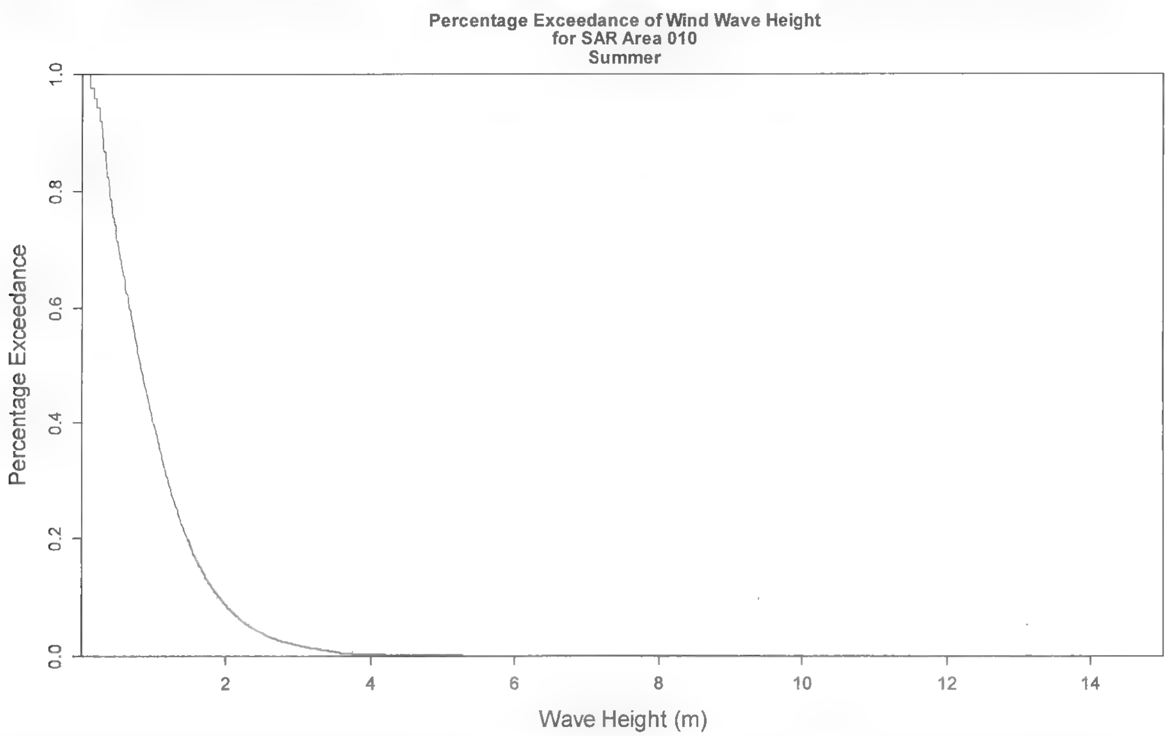

Figure 3.36 SAR Area 010 Summer Wind Wave Height Percentage Exceedance (Grid Point 13408)

Table 3.19 SAR Area 010 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (Grid Point 13408)

Source: MSC50 Total Samples: 20774

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	2.28	2.20	1.86	1.58	1.35	1.42	1.41	1.28	1.52	1.58	1.67	1.57	2.02	2.87	2.41	2.16	29.19
	1.0 - 2.0	2.84	1.93	1.47	1.28	1.58	1.67	1.50	1.49	1.38	1.24	1.39	1.92	2.86	3.25	4.29	4.15	34.24
	2.0 - 3.0	1.96	1.20	0.72	0.70	0.83	1.13	0.85	0.90	0.50	0.44	0.74	1.24	1.56	2.06	3.01	3.16	20.99
	3.0 - 4.0	1.29	0.56	0.33	0.25	0.32	0.54	0.39	0.26	0.10	0.17	0.29	0.56	0.78	0.90	1.51	1.48	9.73
	4.0 - 5.0	0.59	0.26	0.16	0.14	0.20	0.18	0.19	0.06	0.05	0.07	0.13	0.18	0.21	0.28	0.51	0.62	3.85
	5.0 - 6.0	0.26	0.18	0.09	0.03	0.10	0.08	0.05	0.02	0.01	0.03	0.00	0.04	0.10	0.06	0.09	0.22	1.36
	6.0 - 7.0	0.07	0.04	0.00	0.01	0.04	0.09	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.08	0.03	0.48
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.13
	>= 8.0	0.03	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06

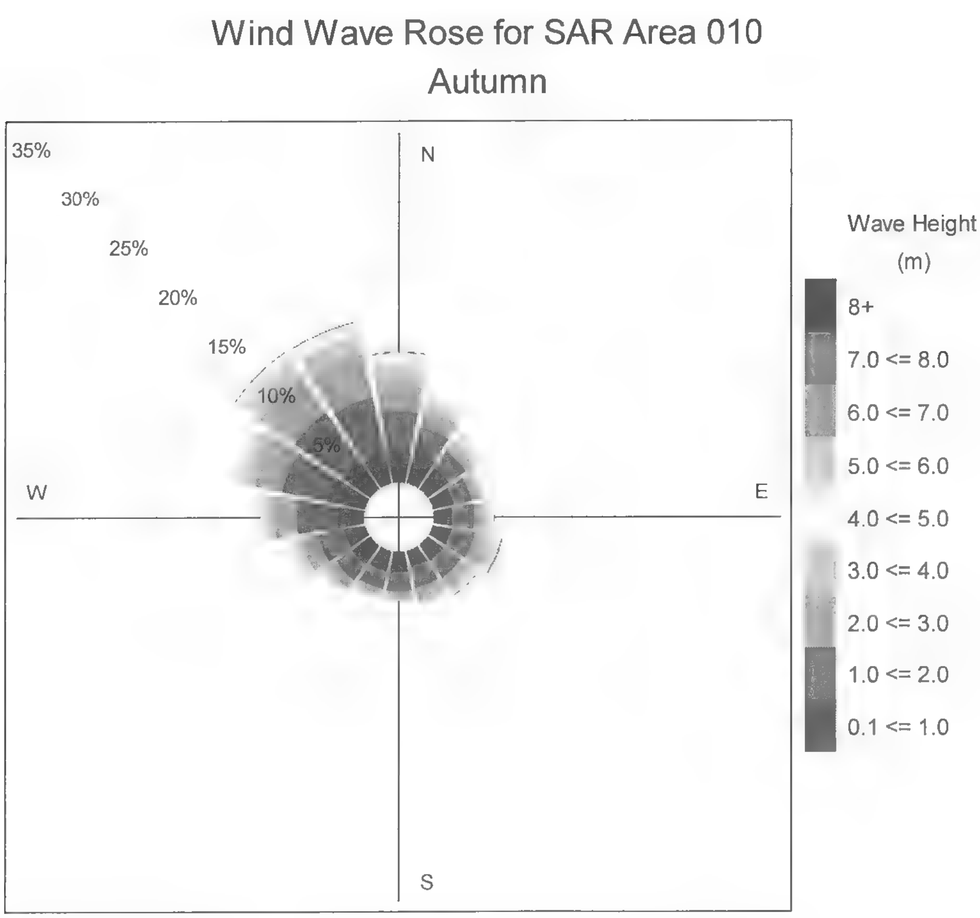

Figure 3.37 SAR Area 010 Autumn Wind Wave Rose Diagram (Grid Point 13408)

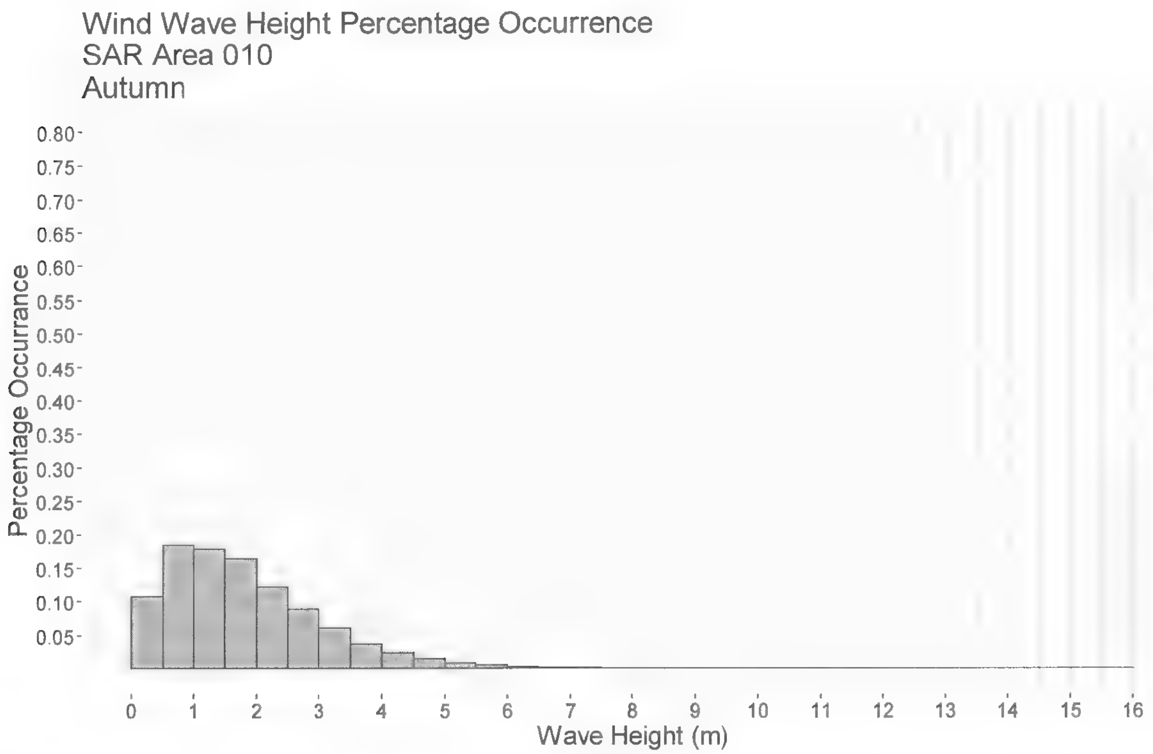

Figure 3.38 SAR Area 010 Autumn Wind Wave Height Percentage Occurrence (Grid Point 13408)

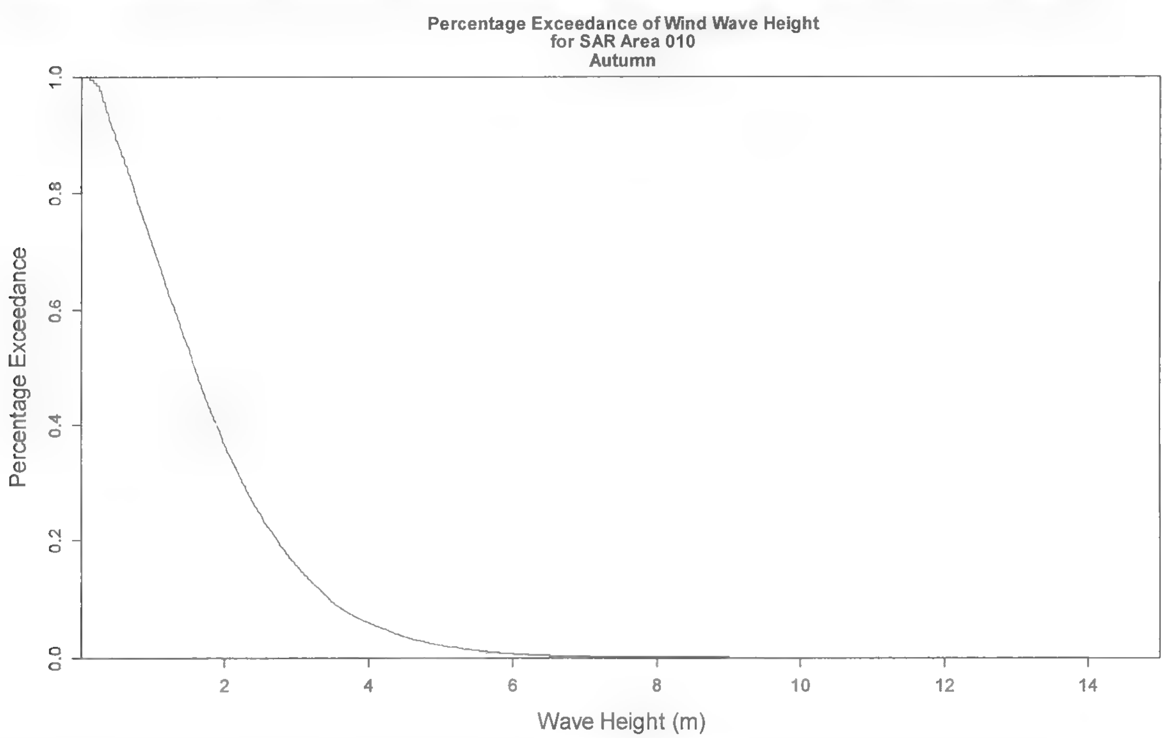

Figure 3.39 SAR Area 010 Autumn Wind Wave Height Percentage Exceedance (Grid Point 13408)

Swell Height

Seasonal mean, standard deviation, mean maximum and absolute maximum swell height statistics are provided in Table 3.20 and Table 3.21 for SAR Area 010.

Tables depicting the joint percentage frequency distribution of swell height and direction are provided in Table 3.22 through Table 3.25.

Wave roses of the seasonal swell height and direction, the associated histogram of the swell height frequency and the swell height percentage exceedance are presented in Figure 3.40 through Figure 3.51. The wave roses are in meteorological convention and depict the direction the waves are coming from.

Table 3.20 SAR Area 010 Seasonal Wave Height Statistics from MSC50 Grid Point 15510 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.0	1.0	5.5	8.2
Spring	0.5	0.7	2.9	8.0
Summer	0.9	0.5	3.2	5.3
Autumn	1.3	0.8	4.8	7.9

Table 3.21 SAR Area 010 Seasonal Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.7	1.5	3.3	7.0
Spring	1.7	1.0	2.4	5.0
Summer	1.4	0.8	3.3	5.0
Autumn	7.5	1.3	5.3	7.5

Table 3.22 SAR Area 010 Winter Joint Percentage Frequency Distribution of Swell Direction versus Swell Height (Grid Point 15510)

Source: MSC50 Total Samples: 16013

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	0.80	5.07	5.33	3.63	3.65	6.18	7.13	4.36	2.40	1.81	1.31	0.74	0.46	0.36	0.31	0.44	43.97
	1.0 - 2.0	0.83	4.64	5.02	3.00	4.35	7.14	6.75	2.90	1.21	0.72	0.69	0.44	0.28	0.16	0.26	0.25	38.64
	2.0 - 3.0	0.08	0.38	0.59	0.55	1.22	3.73	3.33	0.62	0.08	0.07	0.08	0.06	0.01	0.00	0.02	0.04	10.87
	3.0 - 4.0	0.00	0.01	0.09	0.09	0.39	1.75	1.46	0.07	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	3.88
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.06	0.82	0.71	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.04	0.37	0.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.23	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Swell Wave Rose for SAR Area 010
Winter

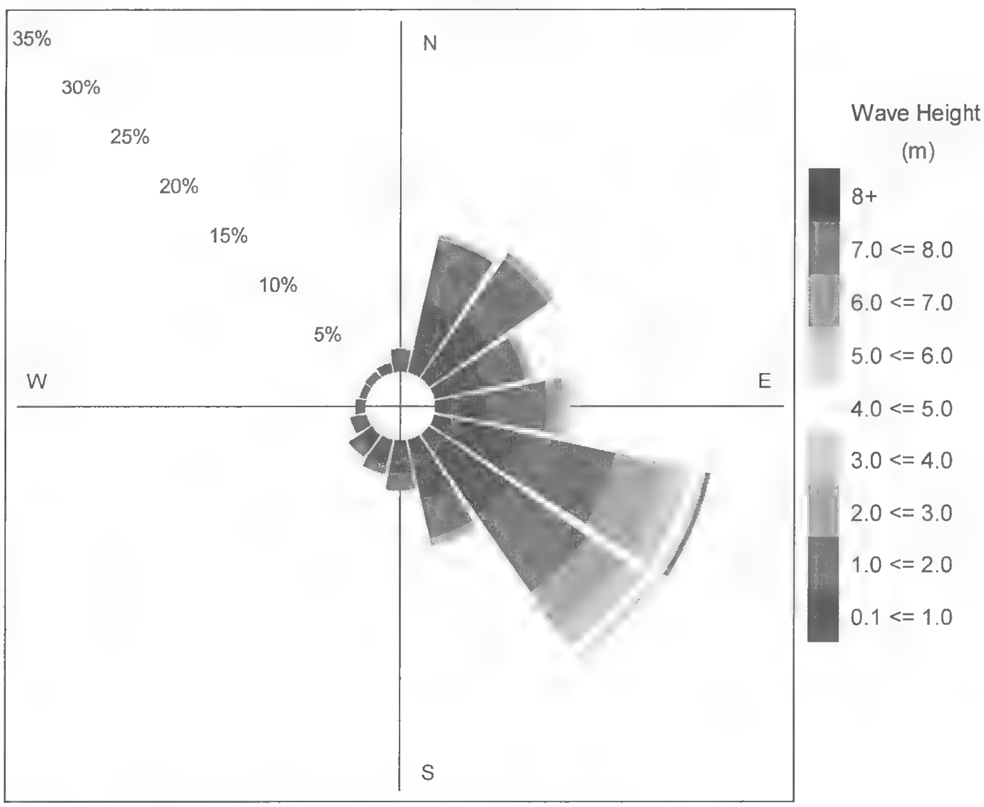

Figure 3.40 SAR Area 010 Winter Swell Rose (Grid Point 15510)

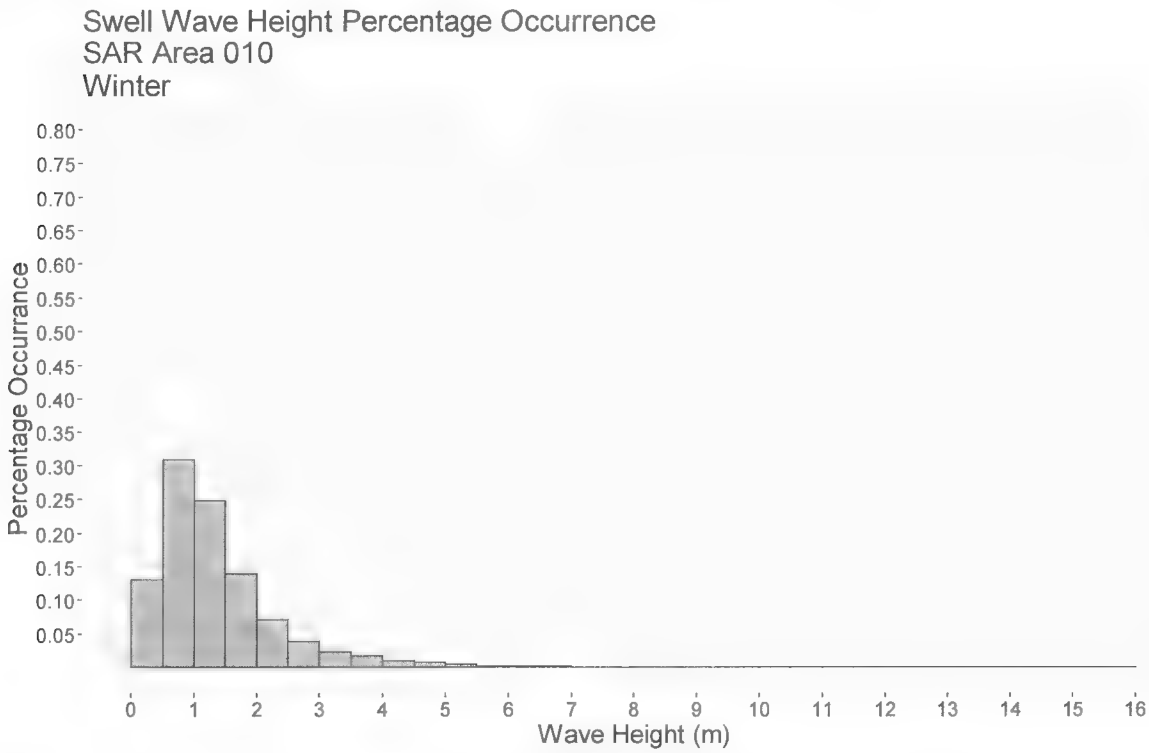

Figure 3.41 SAR Area 010 Winter Swell Height Percentage Occurrence (Grid Point 15510)

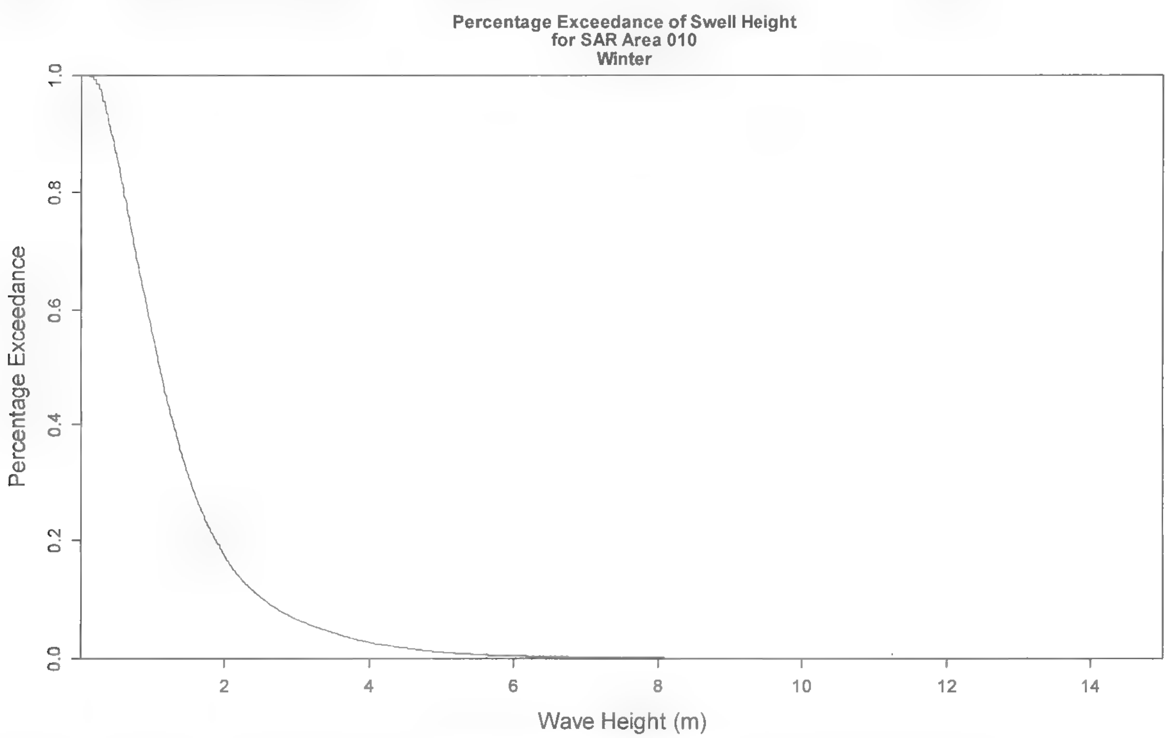

Figure 3.42 SAR Area 010 Winter Swell Height Percentage Exceedance (Grid Point 15510)

Table 3.23 SAR Area 010 Spring Joint Percentage Frequency Distribution of Swell Direction versus Swell Height (Grid Point 15510)

Source: MSC50 Total Samples: 10805

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	0.74	3.42	6.11	5.48	6.86	11.53	15.58	5.72	2.59	1.31	0.53	0.38	0.29	0.29	0.32	0.48	61.62
	1.0 - 2.0	0.09	1.45	1.91	1.58	2.99	8.74	10.37	2.47	0.30	0.06	0.05	0.00	0.00	0.02	0.05	0.04	30.12
	2.0 - 3.0	0.02	0.16	0.19	0.14	0.38	3.29	2.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.28
	3.0 - 4.0	0.00	0.00	0.00	0.00	0.08	0.93	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.03	0.32	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

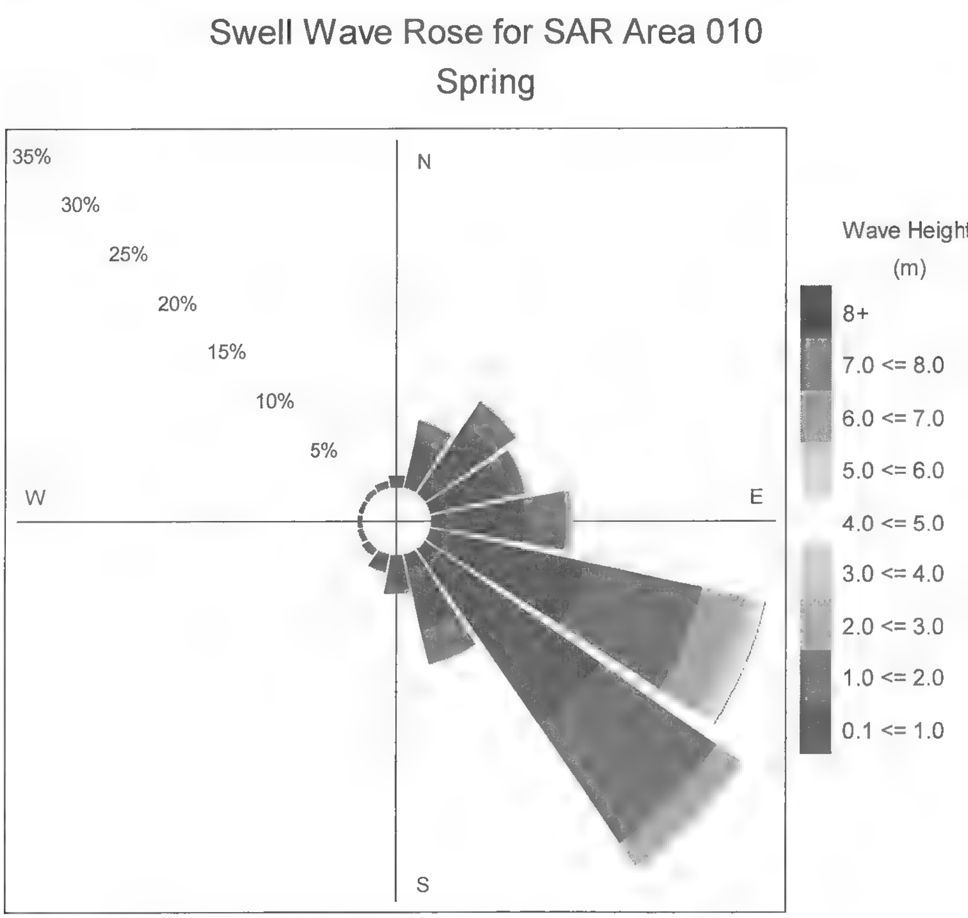

Figure 3.43 SAR Area 010 Spring Swell Rose Diagram (Grid Point 15510)

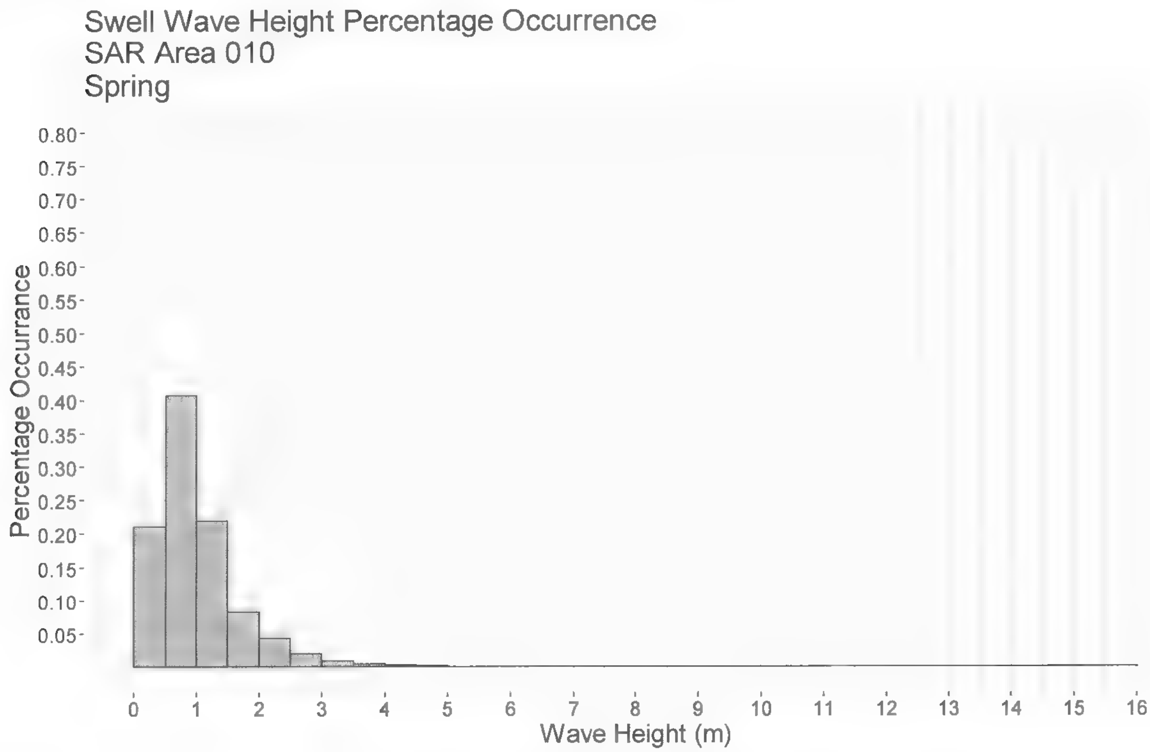

Figure 3.44 SAR Area 010 Spring Swell Height Percentage Occurrence (Grid Point 15510)

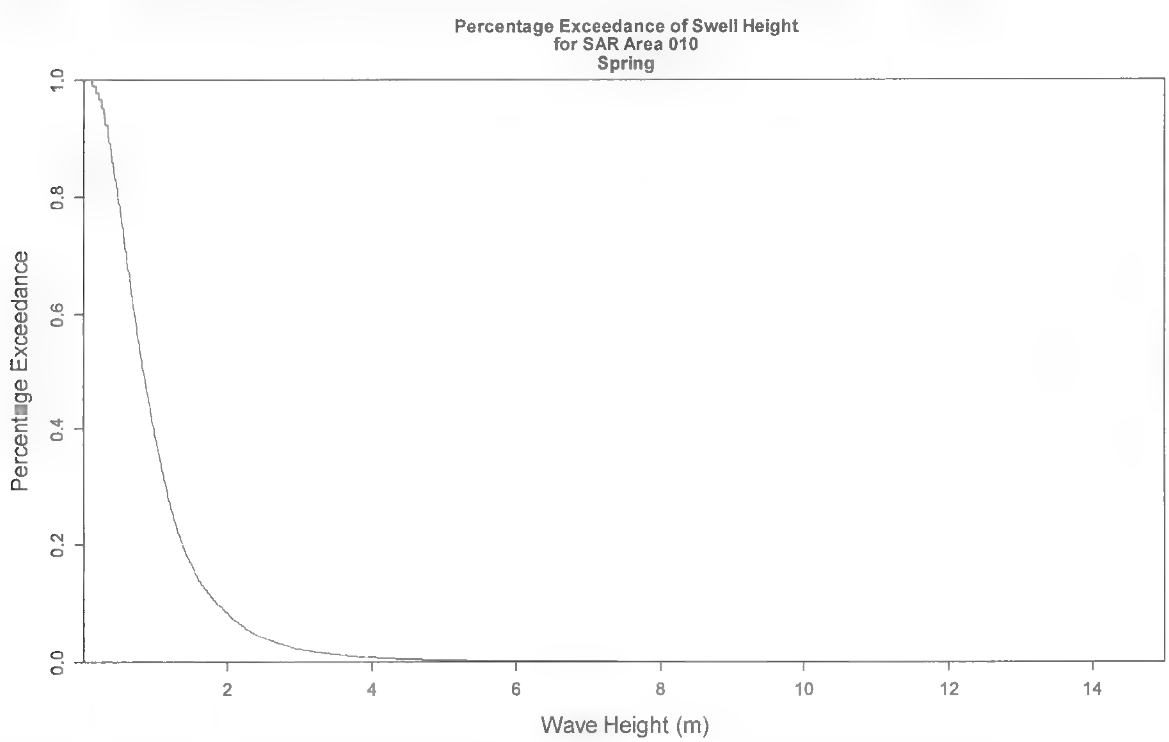

Figure 3.45 SAR Area 010 Spring Swell Height Percentage Exceedance (Grid Point 15510)

Table 3.24 SAR Area 010 Summer Joint Percentage Frequency Distribution of Swell Direction versus Swell Height (Grid Point 15510)

Source: MSC50 Total Samples: 21588

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	1.13	2.82	3.21	2.65	4.00	10.68	20.00	9.51	3.38	1.81	1.40	1.13	0.72	0.51	0.44	0.50	63.88
	1.0 - 2.0	0.39	0.79	0.63	0.82	1.72	10.20	12.32	3.54	0.65	0.32	0.27	0.16	0.19	0.09	0.09	0.12	32.30
	2.0 - 3.0	0.01	0.01	0.02	0.06	0.16	2.39	0.67	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.37
	3.0 - 4.0	0.00	0.00	0.00	0.00	0.00	0.38	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

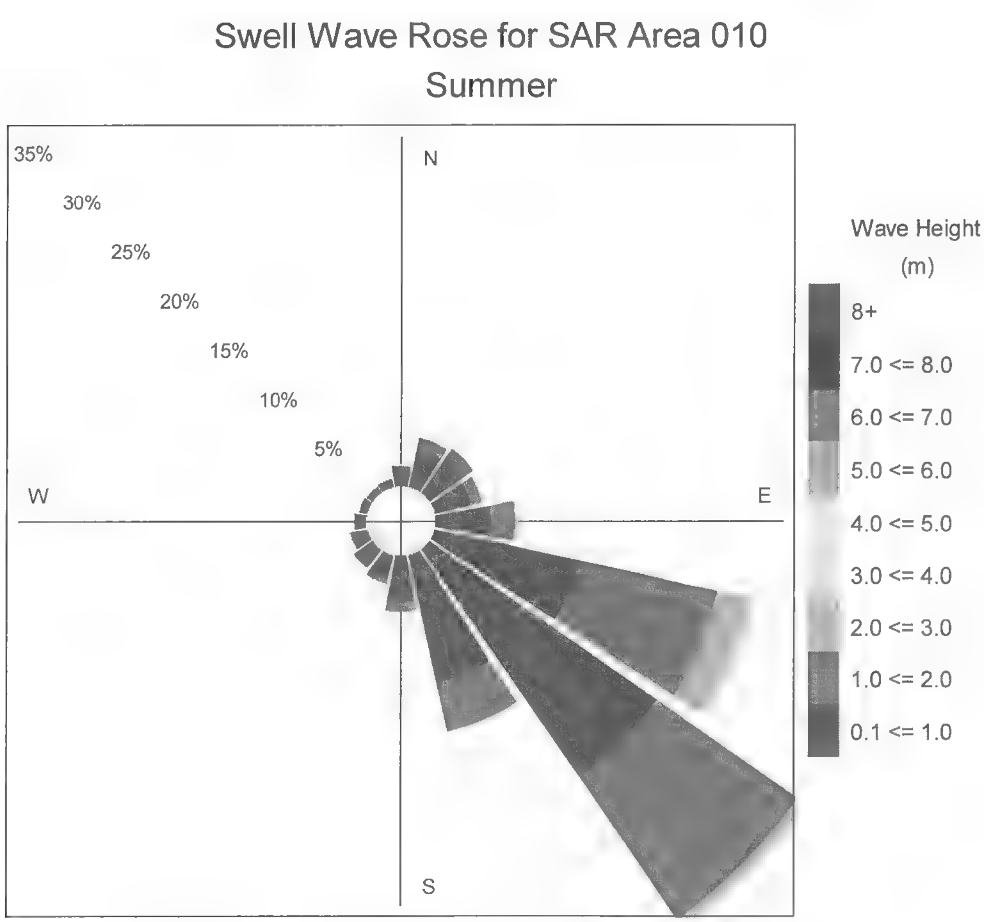

Figure 3.46 SAR Area 010 Summer Swell Rose Diagram (Grid Point 13408)

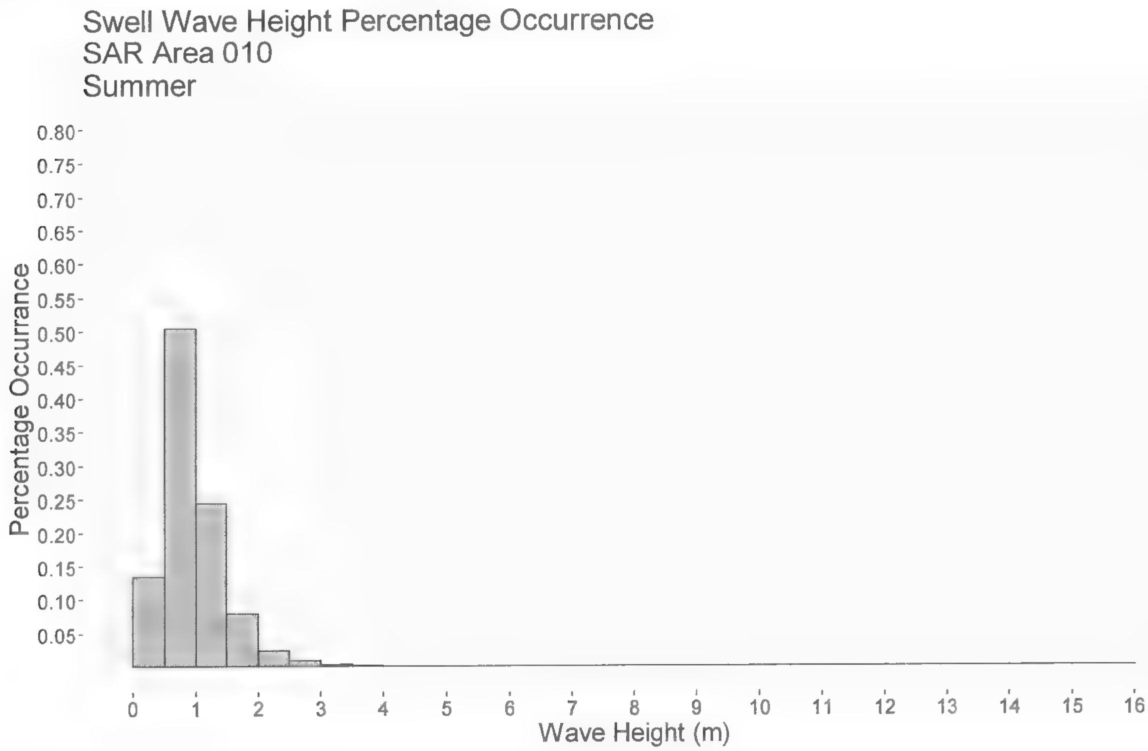

Figure 3.47 SAR Area 010 Summer Swell Height Percentage Occurrence (Grid Point 13408)

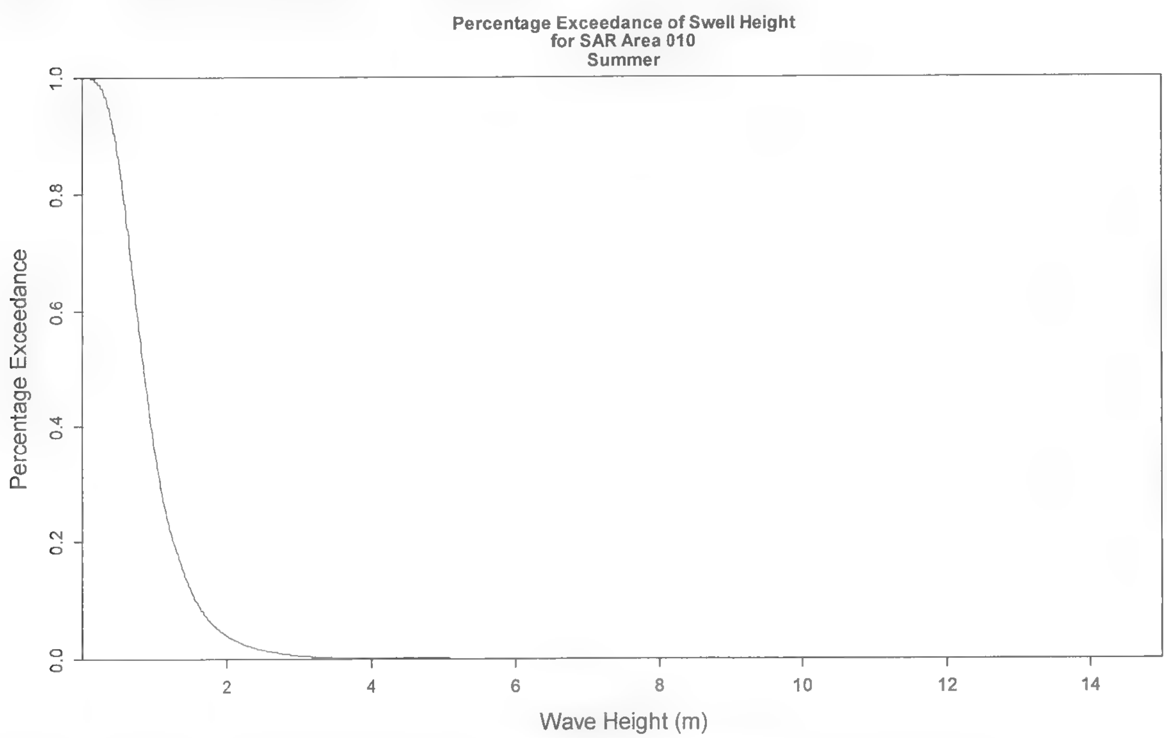

Figure 3.48 SAR Area 010 Summer Swell Height Percentage Exceedance (Grid Point 13408)

Table 3.25 SAR Area 010 Autumn Joint Percentage Frequency Distribution of Swell Direction versus Swell Wave Height (Grid Point 13408)

Source: MSC50 Total Samples: 21834

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	3.14	4.84	2.89	2.08	2.32	3.75	6.79	4.45	2.77	2.18	1.70	1.57	1.15	0.86	1.07	1.52	43.09
	1.0 - 2.0	3.66	5.68	2.84	2.03	2.75	6.01	7.76	4.58	1.89	1.17	0.82	0.85	0.57	0.65	0.95	1.42	43.62
	2.0 - 3.0	0.66	0.99	0.39	0.37	0.82	3.11	2.13	0.83	0.20	0.13	0.06	0.02	0.01	0.02	0.04	0.11	9.90
	3.0 - 4.0	0.02	0.14	0.05	0.07	0.22	1.30	0.53	0.07	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.01	2.46
	4.0 - 5.0	0.00	0.02	0.01	0.00	0.06	0.47	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.16	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.01	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

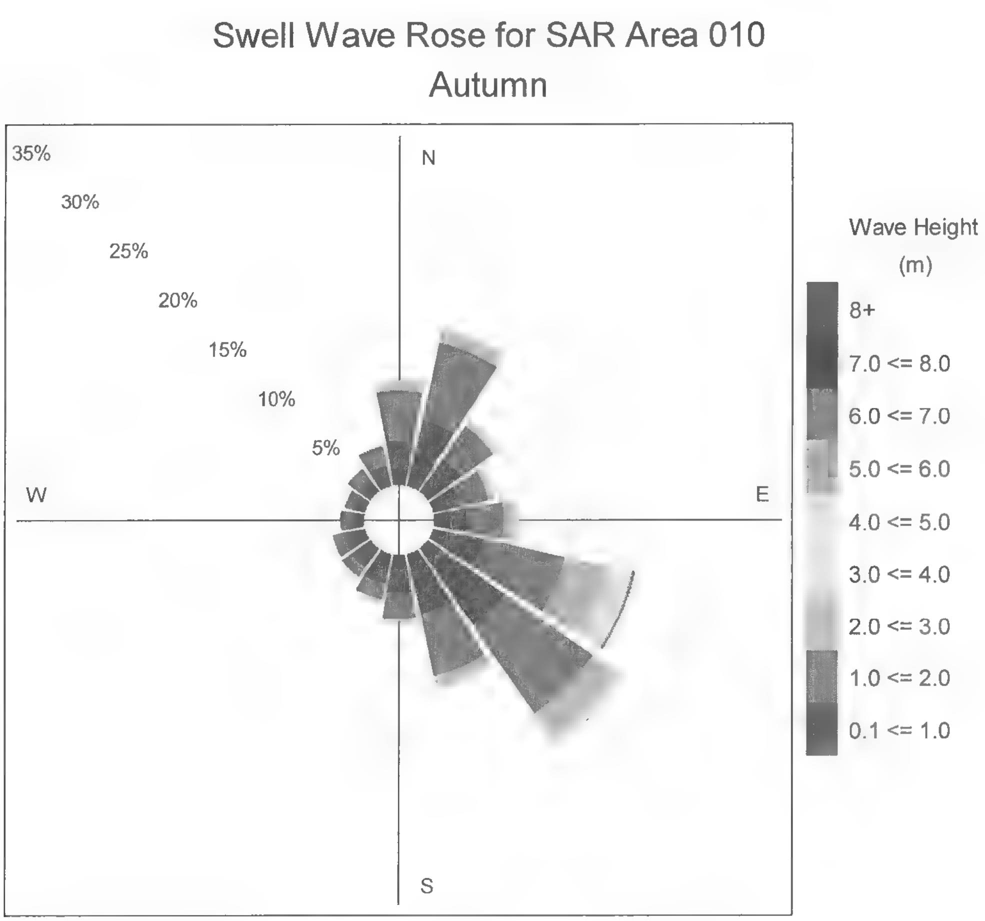

Figure 3.49 SAR Area 010 Autumn Swell Rose Diagram (Grid Point 13408)

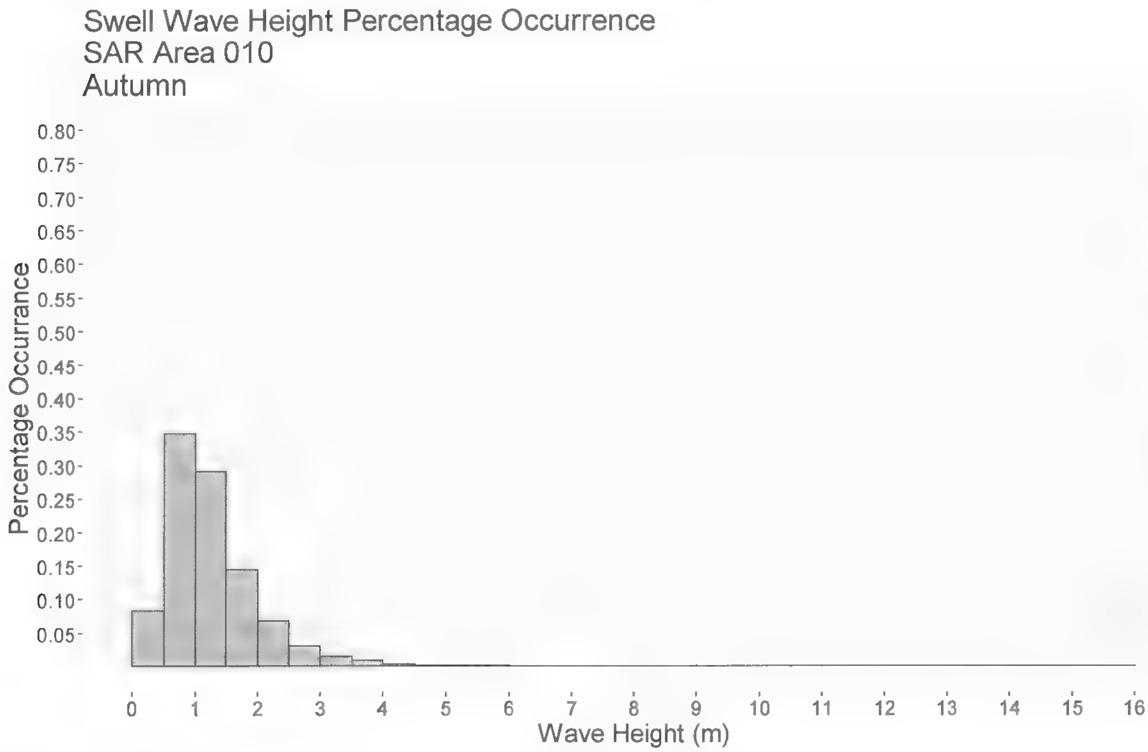

Figure 3.50 SAR Area 010 Autumn Swell Height Percentage Occurrence (Grid Point 13408)

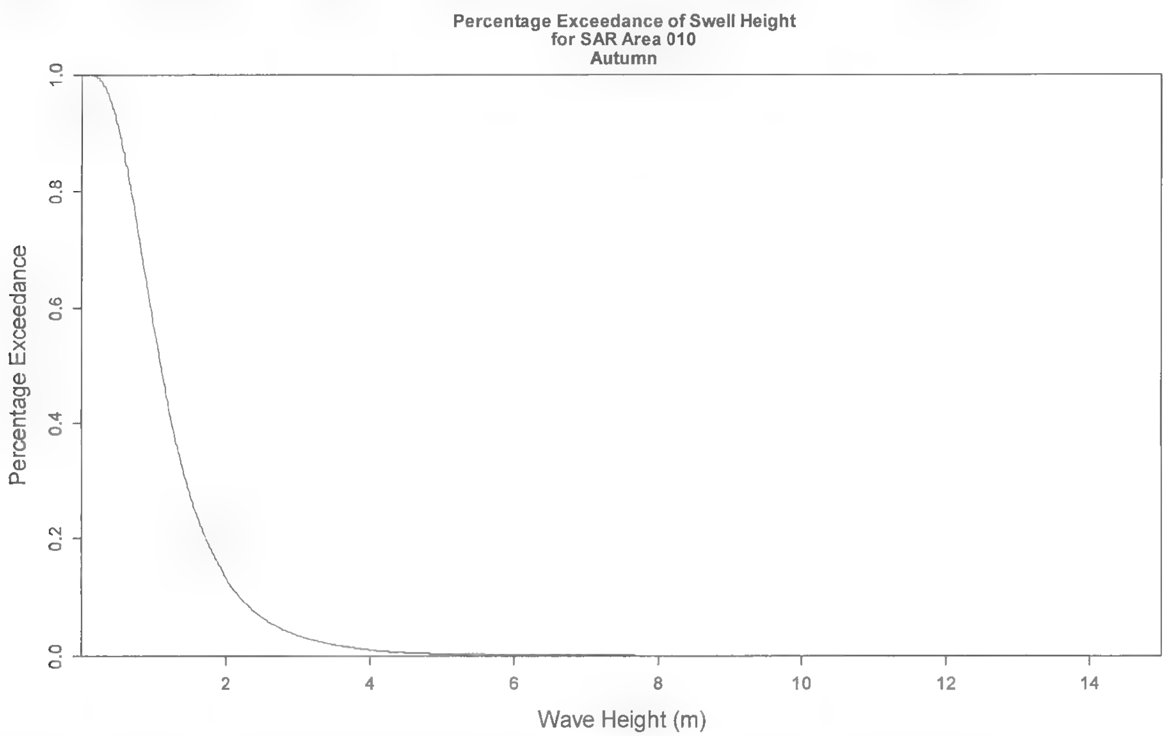

Figure 3.51 SAR Area 010 Autumn Swell Height Percentage Exceedance (Grid Point 13408)

3.1.3 Air and Sea Surface Temperature

Air temperature statistics were obtained from the ISD data base while sea surface temperatures for the area were extracted from the ICOADS data set for SAR Area 010. Seasonal plots of air temperature versus sea surface temperature are presented in Figure 3.52. Air and sea surface temperature statistics are presented in Table 3.26. The atmosphere is coldest in January with a mean seasonal air temperature of -22.9°C, and warmest during July with a mean seasonal air temperature of 6.5°C.

Sea surface temperatures are warmest in August with a mean seasonal temperature of 5.1°C and coldest in December with a mean temperature of 1.7°C.

The mean maximum and mean minimum temperature statistics were calculated by determining the seasons maximum and minimum for each year, then averaging over the number of years of data. These statistics are presented in Table 3.27.

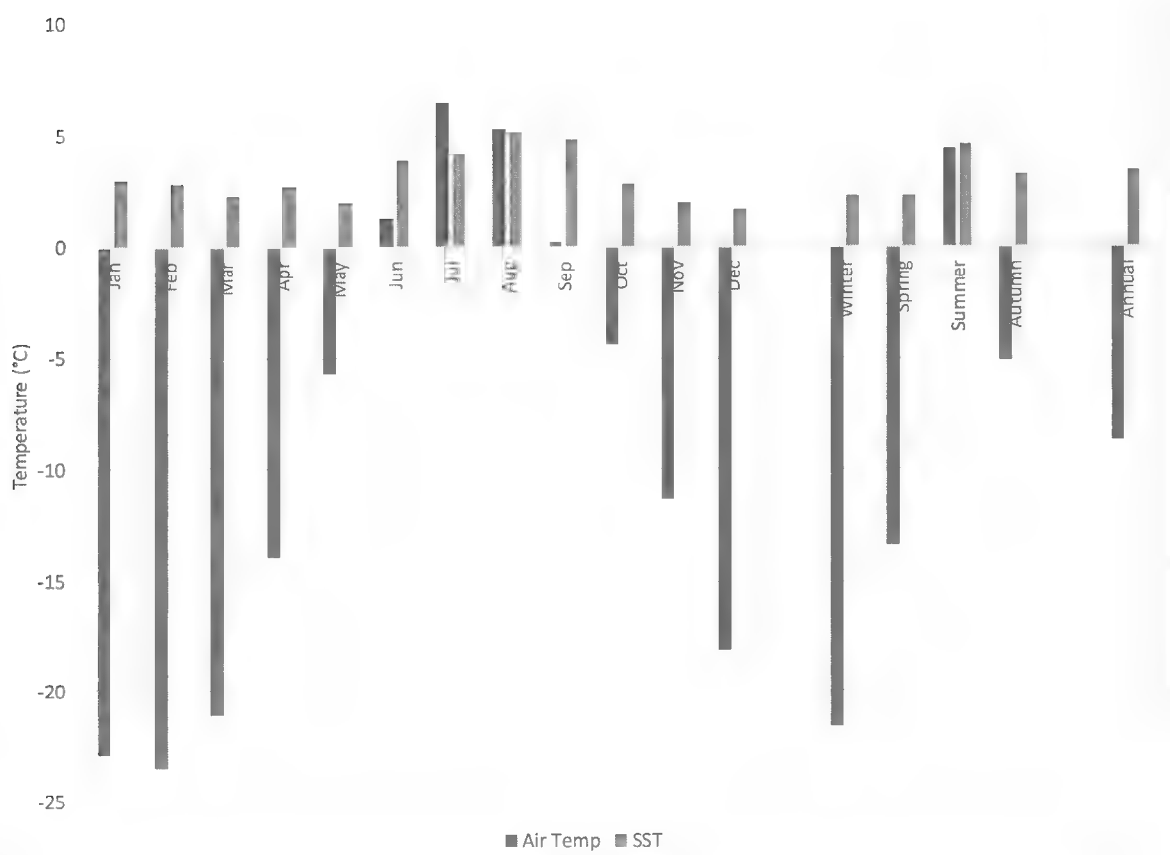

Figure 3.52 Monthly, Seasonal and Annual Mean Air and Sea Surface Temperature (°C) SAR Area 010 (ISD / ICOADS data sets)

Table 3.26 Temperature (°C) Statistics for SAR Area 010

	Air Temperature (°C)				Sea Surface Temperature (°C)			
Month	Mean	Maximum	Minimum	Standard Deviation	Mean	Maximum	Minimum	Standard Deviation
January	-22.9	6.1	-46.0	6.6	3.0	5.7	-2.1	1.8
February	-23.5	6.1	-45.0	6.6	2.8	6.1	-1.8	1.7
March	-21.1	6.0	-43.0	6.7	2.3	8.9	-2.3	1.8
April	-13.9	9.0	-36.0	6.1	2.7	4.8	-2.0	1.1
May	-5.7	13.0	-26.6	4.7	2.0	8.2	-2.1	2.0
June	1.3	17.0	-14.9	3.7	3.9	11.5	-2.0	2.4
July	6.5	23.0	-12.7	4.3	4.2	11.2	-2.0	3.1
August	5.3	21.0	-5.7	3.7	5.1	11.6	-1.5	2.7
September	0.2	15.7	-13.0	3.5	4.8	10.5	-2.0	2.4
October	-4.4	15.0	-23.8	4.3	2.8	8.5	-2.8	2.1
November	-11.3	17.0	-40.0	6.4	2.0	6.9	-2.8	2.1
December	-18.2	17.0	-44.0	7.7	1.7	6.2	-1.7	1.9
Winter	-21.6	10.0	-46.0	7.2	2.3	6.2	-2.1	1.9
Spring	-13.4	13.0	-47.4	8.6	2.3	8.9	-2.8	1.8
Summer	4.4	23.0	-15.5	4.5	4.6	11.6	-2.0	2.9
Autumn	-5.1	25.0	-35.8	6.9	3.2	10.5	-2.8	2.5
Annual	-8.7	37.0	-50.0	11.8	3.4	11.6	-2.8	2.6

Table 3.27 Mean Maximum and Mean Minimum Temperature (°C) Statistics for SAR Area 010

	Air Temperature (°C)		Sea Surface Temperature (°C)	
Month	Mean Maximum	Mean Minimum	Mean Maximum	Minimum Standard Deviation
January	-4.8	-40.1	3.7	-0.1
February	-6.7	-39.7	2.9	0.1
March	-2.6	-38.0	4.0	0.4
April	1.6	-29.7	3.0	0.2
May	8.3	-18.6	4.4	0.4
June	14.3	-7.5	6.3	0.4
July	20.3	-3.3	8.5	-0.8
August	17.9	-2.7	9.4	-0.4
September	12.0	-7.8	8.4	-0.3
October	6.9	-18.0	6.5	-1.1
November	2.4	-29.0	4.9	-1.0
December	0.1	-35.2	4.0	-0.7
Winter	2.3	-41.5	4.5	-1.2
Spring	8.3	-38.2	5.0	-0.7
Summer	20.7	-7.8	9.6	-1.0
Autumn	13.0	-28.4	8.4	-1.4
Annual	21.7	-42.4	9.7	-1.8

3.1.4 Sea Ice

Frequency of Presence

A weekly analysis of the Canadian Ice Service's Frequency of Presence of Sea Ice for the period of 1981 to 2010 was determined for SAR Area 010. These results are presented in Table 3.28 and Figure 3.53. Charts were unavailable for weeks which show no data.

These statistics show that the region is affected by sea ice throughout the year. The Frequency of Presence is highest the week beginning April 02 (Figure 3.54).

It should be noted that there is an area of SAR Area 010 which is not covered by the Arctic Sea Ice charts. The statistics provided below are for the area of coverage.

Table 3.28 Frequency of Presence of Sea Ice within SAR Area 010 (1981 - 2010)

	Ice Free	1-15%	16-33%	34-50%	51-66%	67-84%	85-99%	100%
Jan-01	2.54	3.97	5.34	3.33	2.47	3.07	14.72	64.56
Jan-08								
Jan-15								
Jan-22								
Jan-29	0.00	1.30	7.97	3.28	2.39	5.39	7.66	72.01
Feb-05								
Feb-12								
Feb-19								
Feb-26	0.00	0.64	5.51	4.10	2.94	5.54	9.27	72.00
Mar-05								
Mar-12								
Mar-19								
Mar-26								
Apr-02	0.00	0.65	3.86	4.34	2.87	4.83	7.66	75.79
Apr-09								
Apr-16								
Apr-23								
Apr-30	0.00	2.20	7.19	4.20	1.95	5.00	23.13	56.35
May-07								
May-14	3.98	3.48	4.29	3.39	5.73	8.69	28.91	41.53
May-21								
May-28								
Jun-04	6.77	6.99	4.72	3.83	5.63	11.57	31.24	29.27
Jun-11	12.35	3.83	4.34	3.85	5.65	11.90	28.73	29.34
Jun-18	12.27	4.56	3.23	4.14	6.84	16.51	31.08	21.37
Jun-25	14.58	4.06	3.75	5.48	7.88	19.27	27.13	17.87
Jul-02	15.67	5.51	4.05	6.83	10.83	17.53	20.92	18.65
Jul-09	17.70	5.84	5.11	11.62	11.37	16.87	18.35	13.13
Jul-16	17.91	6.62	11.34	17.85	8.80	11.59	19.05	6.82
Jul-23	19.93	9.86	20.87	12.51	6.84	12.82	14.35	2.82
Jul-30	20.76	17.04	21.32	11.02	8.45	10.79	10.26	0.36
Aug-06	25.87	22.56	17.83	11.04	6.66	12.68	3.07	0.28
Aug-13	27.58	28.89	18.92	10.86	8.32	4.28	1.14	0.00
Aug-20	43.35	21.76	19.14	11.09	2.48	2.00	0.17	0.00
Aug-27	49.07	23.27	21.60	4.23	0.97	0.86	0.00	0.00
Sep-03	52.10	32.30	12.98	1.97	0.62	0.03	0.00	0.00
Sep-10	53.07	37.78	8.18	0.96	0.00	0.00	0.00	0.00
Sep-17	64.11	32.47	3.42	0.00	0.00	0.00	0.00	0.00

Sep-24	65.46	33.83	0.72	0.00	0.00	0.00	0.00	0.00
Oct-01	71.19	26.96	1.85	0.00	0.00	0.00	0.00	0.00
Oct-08	71.52	23.23	4.41	0.84	0.01	0.00	0.00	0.00
Oct-15	64.23	27.87	5.05	2.10	0.67	0.08	0.00	0.00
Oct-22	50.23	29.84	12.44	2.98	2.77	1.71	0.03	0.00
Oct-29	42.28	25.48	19.71	5.44	2.16	3.71	1.23	0.00
Nov-05	41.61	14.51	13.13	13.31	7.29	5.43	4.32	0.40
Nov-12	26.25	16.48	17.83	6.83	4.51	14.36	10.52	3.23
Nov-19	17.60	14.68	18.96	10.32	6.23	8.16	16.14	7.93
Nov-26	8.06	15.90	11.82	10.74	9.08	14.24	16.26	13.91
Dec-04	11.25	6.48	6.71	9.58	6.34	17.77	21.61	20.25

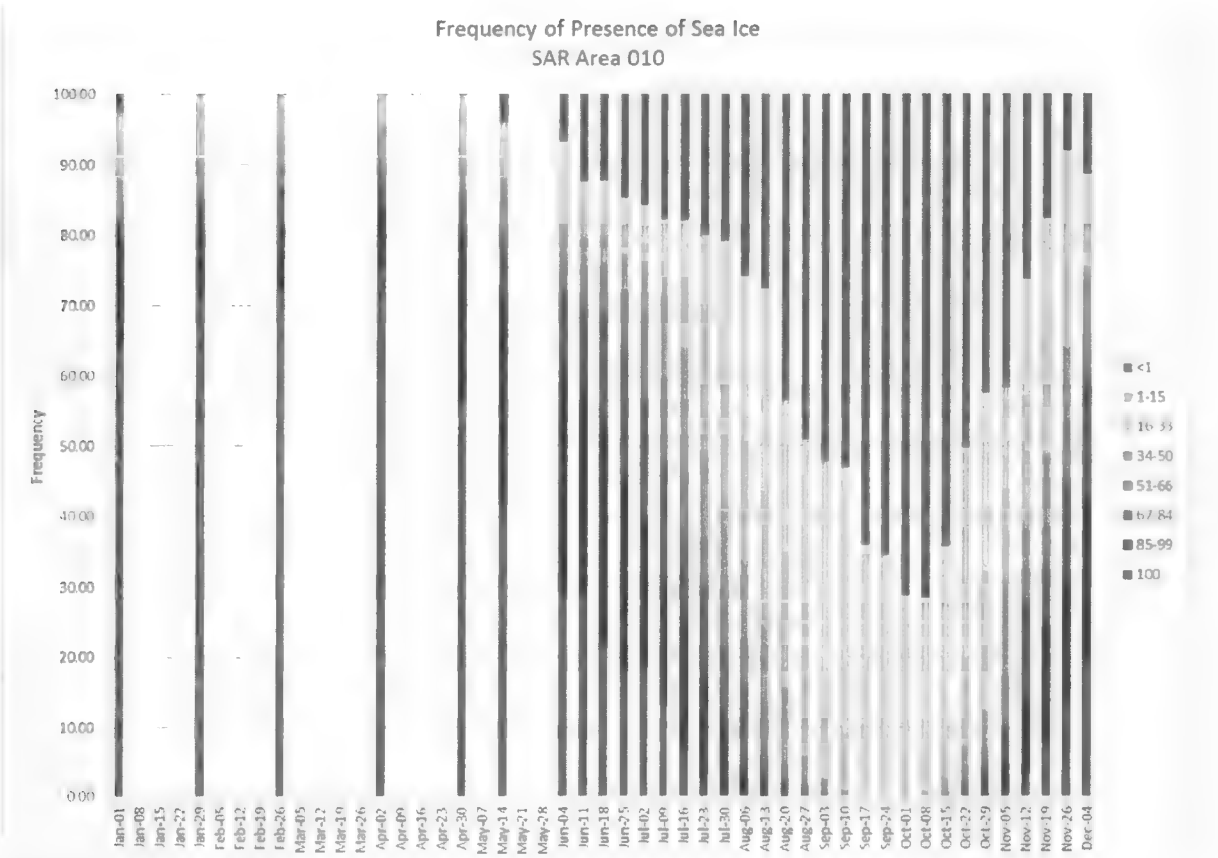

Figure 3.53 Plot of Frequency of Presence of Sea Ice within SAR Area 010 (1981 - 2010)

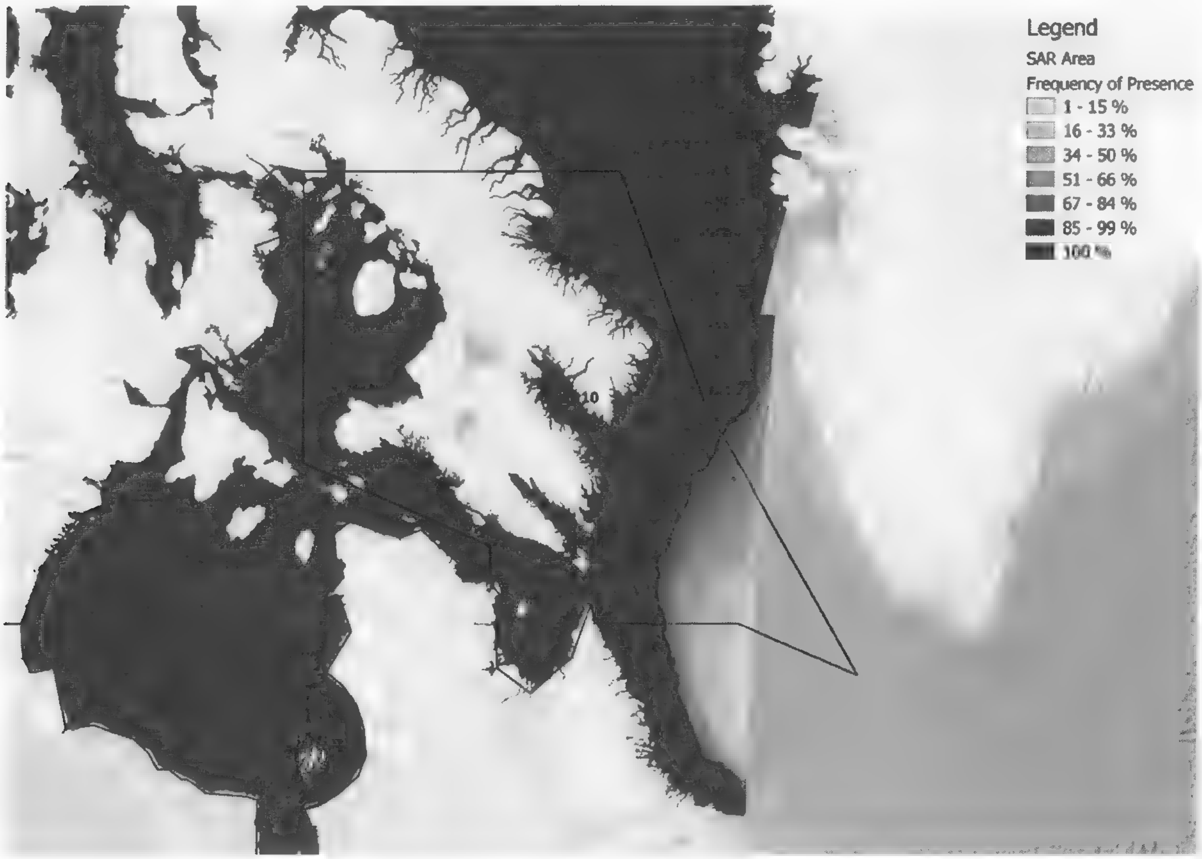

Figure 3.54 Frequency of Presence of Sea Ice for the week of February 26 within SAR Area 010 (1981 - 2010)

Median Concentration of Sea Ice

The weeks beginning January 29 and February 26 has the highest coverage of sea ice concentration greater than 7 tenths. Sea Ice concentrations reach 100% for the weeks beginning January 29 through April 02 (Table 3.29 and Figure 3.55). Figure 3.56 depicts the median concentration of sea ice for the week of February 26.

Table 3.29 Median Concentration of Sea Ice within SAR Area 010 (1981 - 2010)

	Ice Free	1/10 - 3/10	4/10 - 6/10	7/10 - 8/10	9/10 - 9+/10	10/10	Total Ice
Jan-01	2.54	0.00	1.57	2.54	83.64	9.70	97.46
Jan-08							
Jan-15							
Jan-22							
Jan-29	0.00	0.00	0.00	0.70	86.96	12.34	100.00
Feb-05							
Feb-12							
Feb-19							
Feb-26	0.00	0.00	0.00	0.10	85.98	13.91	100.00
Mar-05							
Mar-12							
Mar-19							
Mar-26							
Apr-02	0.00	0.00	1.68	4.13	79.43	14.76	100.00
Apr-09							
Apr-16							
Apr-23							
Apr-30	0.00	0.04	0.62	2.95	81.98	14.41	100.00
May-07							
May-14	3.98	2.48	3.31	8.35	67.77	14.11	96.02
May-21							
May-28							
Jun-04	10.25	2.11	5.72	8.04	60.80	13.08	89.75
Jun-11	12.35	0.07	6.71	16.57	50.32	13.98	87.65
Jun-18	12.27	3.66	13.64	15.14	42.62	12.66	87.73
Jun-25	14.58	4.22	15.95	15.78	37.93	11.54	85.42
Jul-02	15.67	4.26	25.33	12.84	32.52	9.37	84.33
Jul-09	17.70	10.35	25.81	12.68	26.67	6.79	82.30
Jul-16	17.91	15.48	25.41	13.72	23.71	3.77	82.09
Jul-23	19.93	23.49	24.85	11.70	18.47	1.56	80.07
Jul-30	20.76	31.73	21.66	15.94	8.91	1.00	79.24
Aug-06	25.87	26.97	33.45	6.34	7.01	0.36	74.13
Aug-13	27.61	36.63	26.99	6.13	2.52	0.12	72.39
Aug-20	43.35	31.27	18.77	4.08	2.52	0.00	56.65
Aug-27	49.08	31.97	13.48	3.47	2.01	0.00	50.92
Sep-03	52.10	28.10	12.98	2.46	4.32	0.05	47.90

Sep-10	53.07	27.84	12.41	2.63	4.05	0.00	46.93
Sep-17	64.11	20.20	9.10	3.13	3.45	0.01	35.89
Sep-24	65.46	17.97	5.10	5.92	5.55	0.00	34.54
Oct-01	71.19	12.74	10.33	2.63	3.11	0.00	28.81
Oct-08	71.52	10.38	6.79	7.54	3.78	0.00	28.48
Oct-15	64.23	6.07	5.08	3.19	21.44	0.00	35.77
Oct-22	50.23	3.08	16.98	6.84	22.86	0.00	49.77
Oct-29	42.28	0.72	9.09	5.86	41.96	0.09	57.72
Nov-05	41.61	0.70	4.65	15.24	37.71	0.09	58.39
Nov-12	26.25	0.87	15.16	6.91	50.42	0.40	73.75
Nov-19	17.60	2.79	11.69	65.78	2.14	0.00	82.40
Nov-26	8.06	0.00	7.82	4.87	76.30	2.96	91.94
Dec-04	11.25	0.00	0.53	2.64	80.31	5.26	88.75

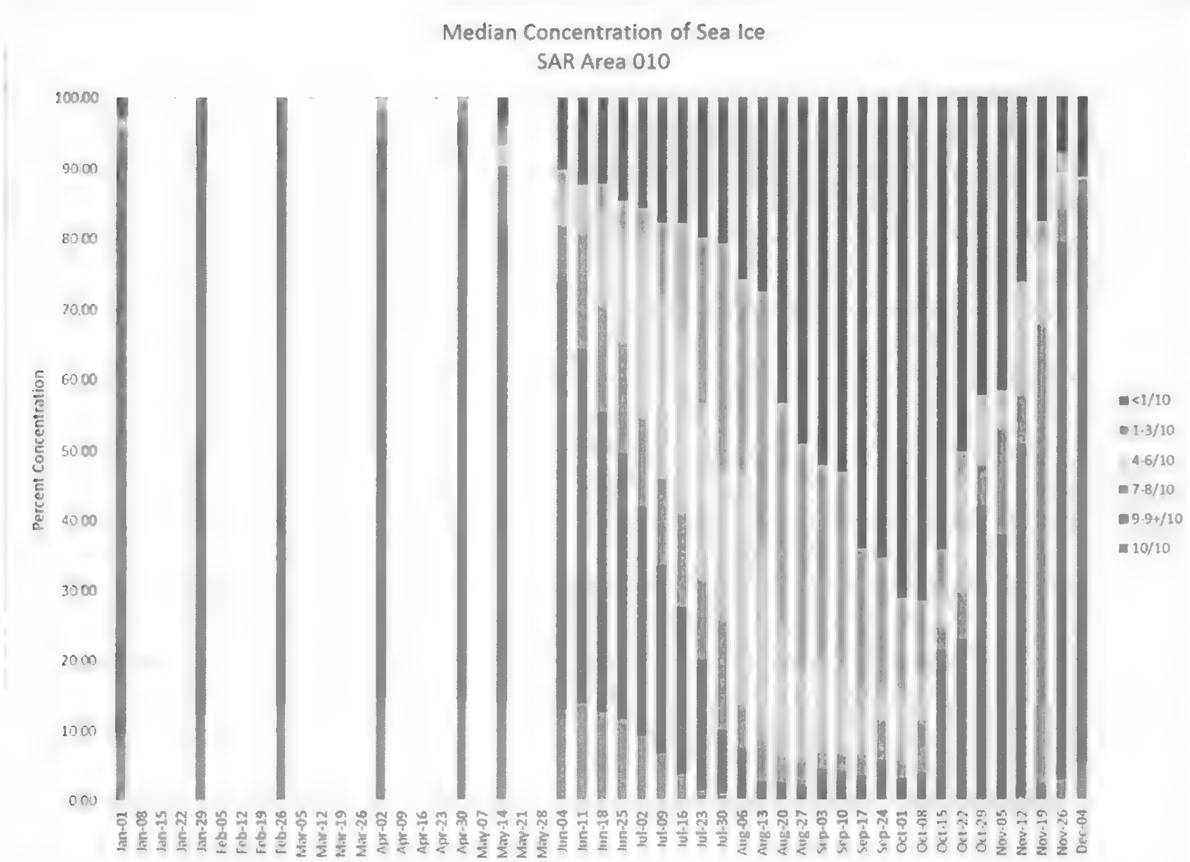

Figure 3.55 Plot of Median Concentration of Sea Ice within SAR Area 010 (1981 - 2010)

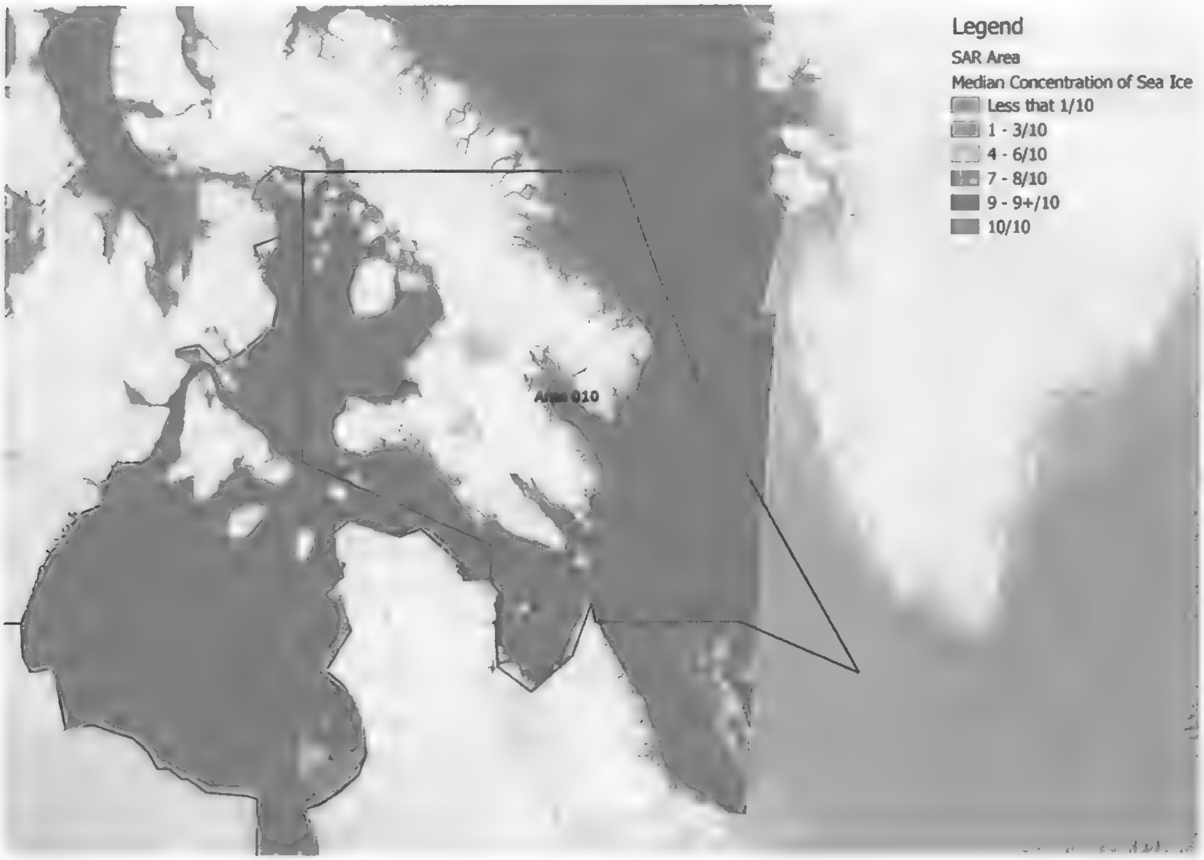

Figure 3.56 Median Concentration of Sea Ice for the week of February 26 within SAR Area 010 (1981 - 2010)

Predominant Ice Type

The presence of thick sea ice occurs within SAR Area 010 throughout the year. The week of February 26 has the highest concentration of thick sea ice with 99.98% of the region covered in ice at least 15 cm thick and a concentration of 7 tenths or greater. During this period, charts of the "Median Concentration of Ice when Ice is Present" indicate that 99.9% of the sea ice present is greater than 9 tenths.

A chart depicting the predominant ice type when ice is present for the week of February 26 is provided below in Figure 3.57.

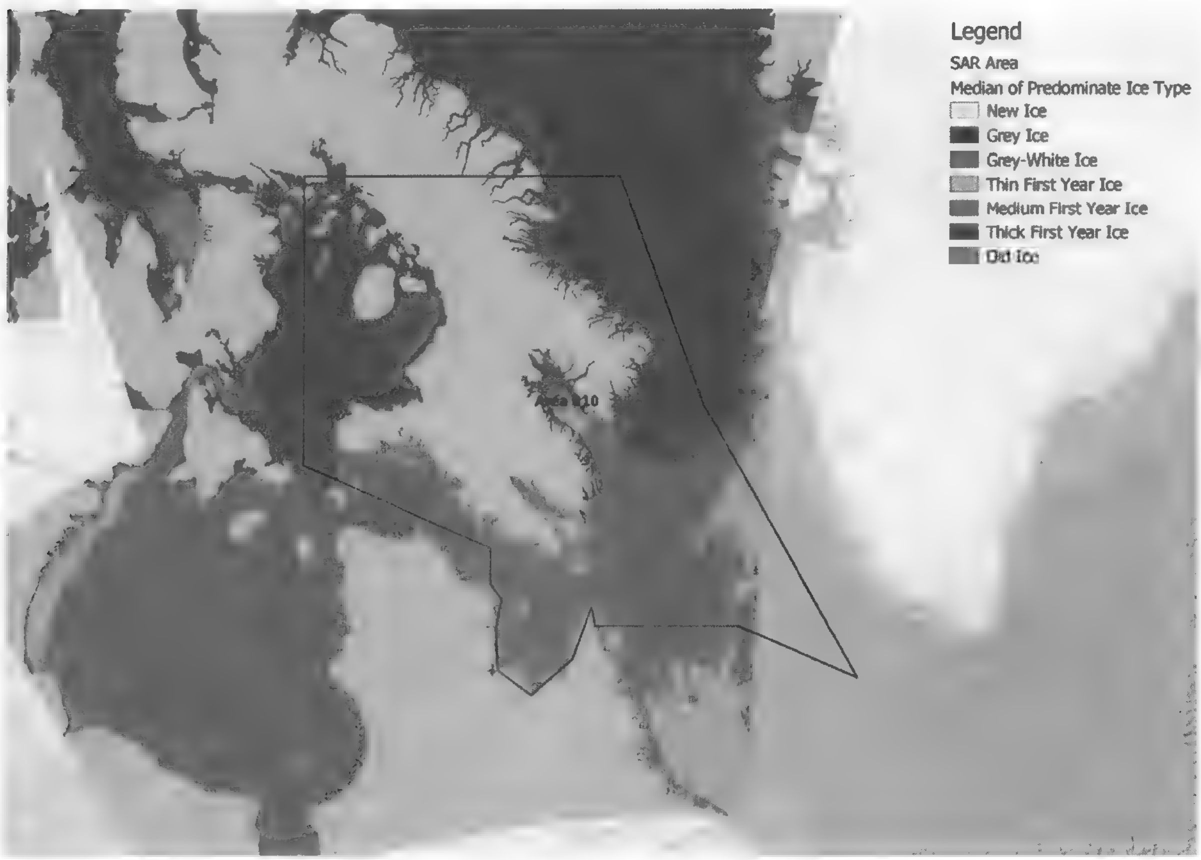

Figure 3.57 Median of Predominant Ice Type when Ice is Present (February 26)

3.1.5 *Summary Climate Statistics*

Table 3.30 Area 010 Summary Climate Statistics

Parameter	Description	Winter			Spring			Summer			Autumn		
Wind Direction	Prevailing Wind Direction	NW			NNW			NNW			NW		
Wind Speed	Mean Seasonal (knots)	17.5			13.4			10.5			16.7		
	Mean Seasonal Maximum (kts)	39.7			33.4			28.7			39.2		
Significant Wave Height	Percentage Frequency > 2.0 m	58.1			28.2			13.8			51.8		
Air Temperature	Mean Temperature (°C)	-6.5			-4.3			5.1			0.4		
Sea Surface Temperature	Mean Seasonal Maximum Temperature (°C)	4.5			5.0			9.6			8.4		
	Mean Seasonal Minimum Temperature (°C)	-1.2			-0.7			-1.0			-1.4		
Seasonal Sea Ice Coverage	Mean Days per Season of Ice with concentration > 7/10 and thickness > 15cm	90			92			92			91		
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	83.5			95.9			41.0			9.2		
Seasonal Sea Ice Type	New Ice	Y			Y						Y		
	Grey Ice	Y			Y						Y		
	Grey-White Ice	Y			Y						Y		
	Thin First Year Ice	Y			Y			Y			Y		
	Medium First Year Ice	Y			Y			Y					
	Thick First Year Ice	Y			Y			Y					
	Old Ice							Y			Y		
		D	J	F	M	A	M	J	J	A	S	O	N
Monthly Sea Ice Coverage	Mean Days per Month of Ice with concentration > 7/10 and thickness > 15cm	31	31	28	NA	30	31	30	31	31	30	31	30
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	42.9	95.7	100	NA	98.8	90.2	74.6	39.9	8.6	7.8	3.4	17.9
Monthly Sea Ice Type	New Ice	Y	Y		NA	Y						Y	Y
	Grey Ice	Y	Y		NA	Y						Y	Y
	Grey-White Ice	Y	Y	Y	NA	Y						Y	Y
	Thin First Year Ice	Y	Y	Y	NA	Y	Y						Y
	Medium First Year Ice		Y	Y	NA	Y	Y	Y	Y		Y		
	Thick First Year Ice			Y	NA	Y	Y	Y	Y	Y	Y		
	Old Ice				NA			Y	Y	Y	Y	Y	Y

3.2 SAR Area 155

3.2.1 Wind Speed and Direction

Wind speed statistics from the ISD and ICOADS data sets for SAR Area 155 are presented in Table 3.31 and Table 3.32. Hindcast data from the MSC50 data set is not available for this region. Annual wind speed vectors for the ISD data set are provided in Figure 3.58. The highest absolute maximum wind speed of 48.0 knots was recorded in the ICOADS data set during the autumn season.

Wind roses of the seasonal wind speed and direction, the associated histogram of the wind speed frequency and the wind speed percentage exceedance plots for the ISD data set are presented in Figure 3.59 through Figure 3.70.

During the winter months, winds are generally from the west to west-northwest, with the predominant wind being a 20-30 knot westerly wind. As spring approaches, the frequency of west to west-northwest winds decreases. The predominate wind speed continues to be from a northwesterly direction with the most frequent wind speed being 10-20 knots from the northwest. South to south-southwest winds become more predominate during the summer months with 6% of all wind speeds being from the south-southwest at 10-20 knots. By autumn, winds become more west to west-northwest once again with the 10-20 knot westerly wind being the most predominate (Table 3.33 through Table 3.36).

Gale force winds are more frequent during the winter months. Wind speeds greater than 30 knots occur 14.7% of the time during the winter months, but only 0.1% of the time during the summer.

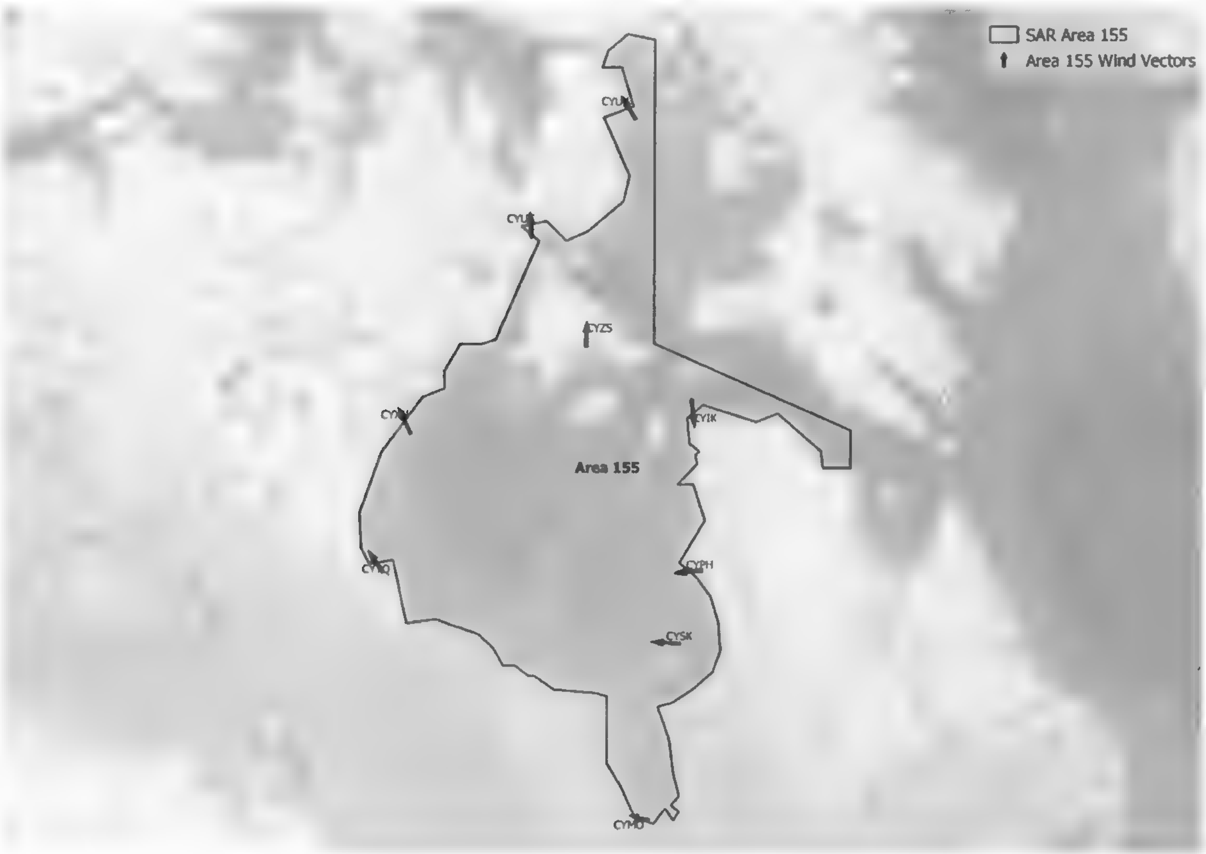

Figure 3.58 Annual Wind Vectors for SAR Area 155

Table 3.31 SAR Area 155 Seasonal Wind Speed Statistics from the ISD data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	11.4	6.2	38.2	39.1
Spring	11.3	6.0	37.4	38.1
Summer	9.9	5.2	32.7	33.0
Autumn	12.1	6.5	40.4	41.0

Table 3.32 SAR Area 155 Seasonal Wind Speed Statistics from the ICOADS data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	15.7	6.6	18.6	29.9
Spring	16.7	8.0	16.7	23.3
Summer	12.1	6.2	33.8	40.0
Autumn	14.8	7.5	40.7	48.0

Table 3.33 SAR Area 155 Winter Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD — Total Samples: 482504

Wind Speed (knots)	Wind Direction (true / from)																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	6.43	1.91	2.21	2.31	2.71	1.40	1.25	1.46	2.87	2.37	3.01	3.09	6.20	4.93	5.27	5.03	50.05
10 - 20	6.19	1.10	1.07	1.12	1.33	0.67	0.73	1.20	2.43	1.57	1.81	1.89	3.88	4.97	6.22	5.37	38.92
20 - 30	1.84	0.44	0.31	0.22	0.29	0.17	0.19	0.37	0.85	0.37	0.34	0.44	0.76	1.14	1.90	1.65	10.46
30 - 40	0.10	0.04	0.02	0.02	0.02	0.03	0.01	0.02	0.05	0.02	0.01	0.02	0.02	0.05	0.08	0.08	0.55
40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

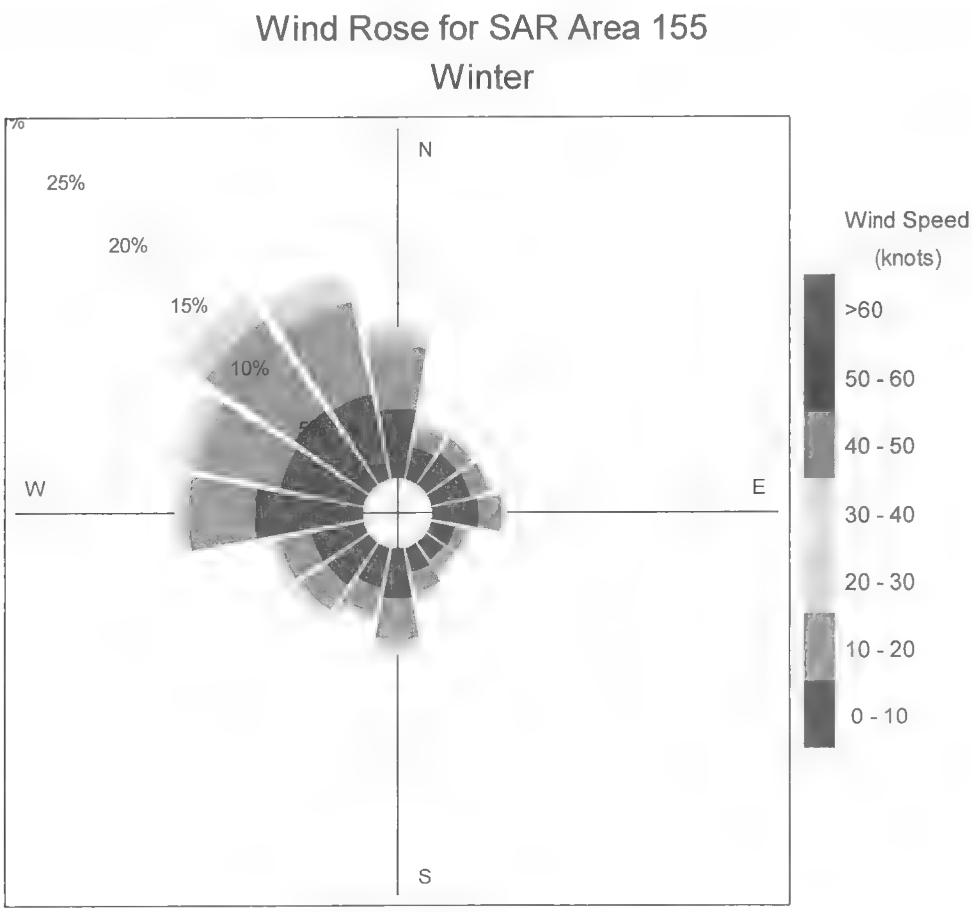

Figure 3.59 SAR Area 155 Winter Wind Rose (ISD)

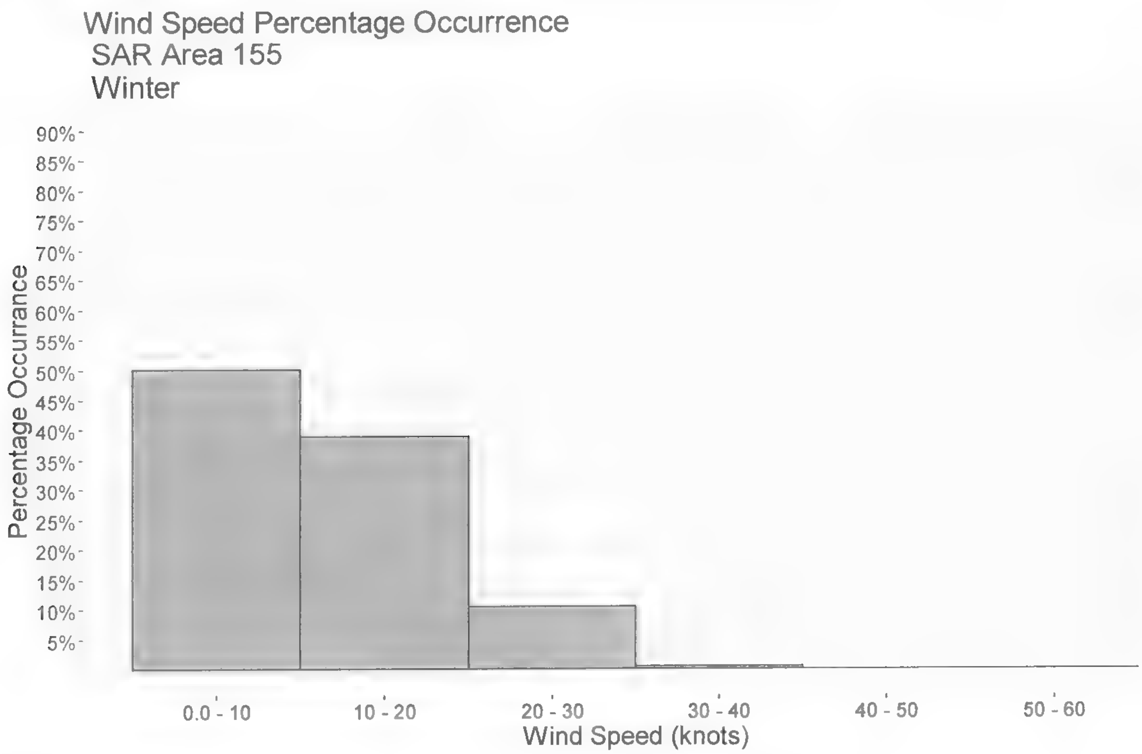

Figure 3.60 SAR Area 155 Winter Wind Speed Percentage Occurrence (ISD)

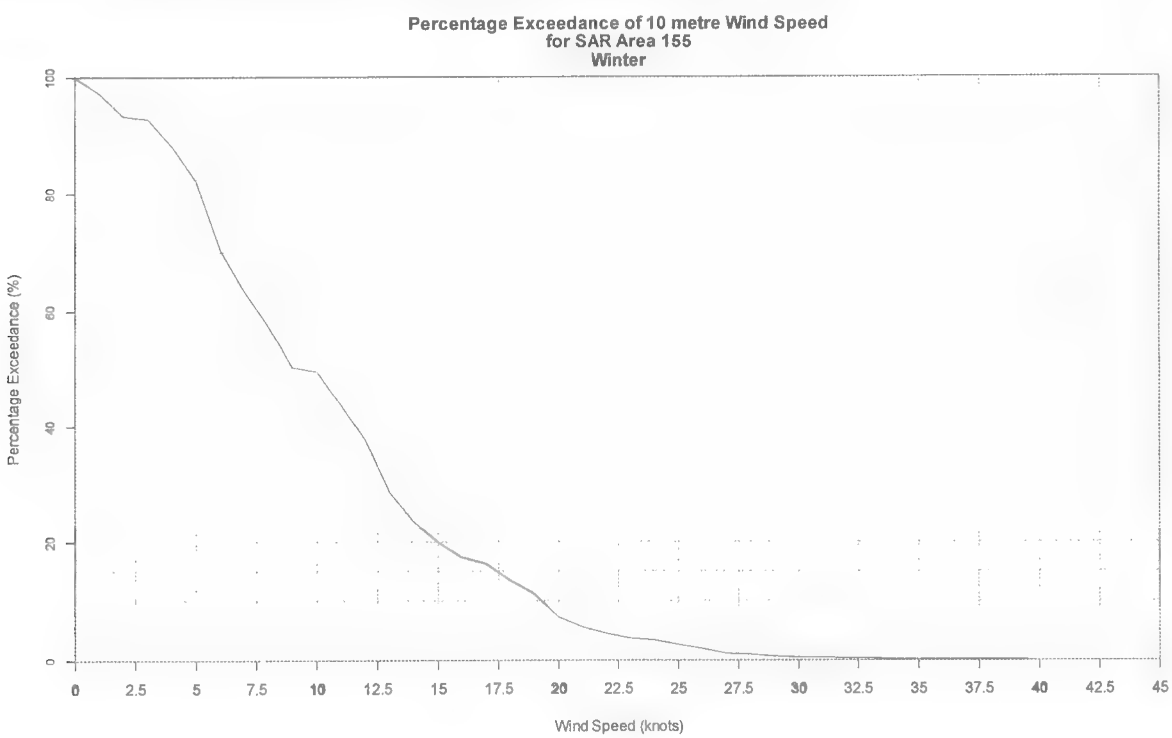

Figure 3.61 SAR Area 155 Winter Wind Speed Percentage Exceedance (ISD)

Table 3.34 SAR Area 155 Spring Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD | Total Samples: 496150

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	8.20	2.77	2.81	2.86	3.75	1.84	1.58	1.69	3.08	2.13	2.20	1.98	4.12	3.77	4.94	5.25	50.30
	10 - 20	7.21	1.93	1.89	1.90	2.63	1.30	1.16	1.56	2.71	1.37	1.23	1.16	2.66	3.34	5.23	5.23	39.80
	20 - 30	1.71	0.55	0.48	0.39	0.47	0.28	0.29	0.49	0.82	0.28	0.20	0.23	0.56	0.89	1.34	1.15	9.47
	30 - 40	0.05	0.03	0.03	0.02	0.02	0.02	0.01	0.03	0.03	0.00	0.01	0.01	0.01	0.05	0.06	0.03	0.40
	40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Rose for SAR Area 155
Spring

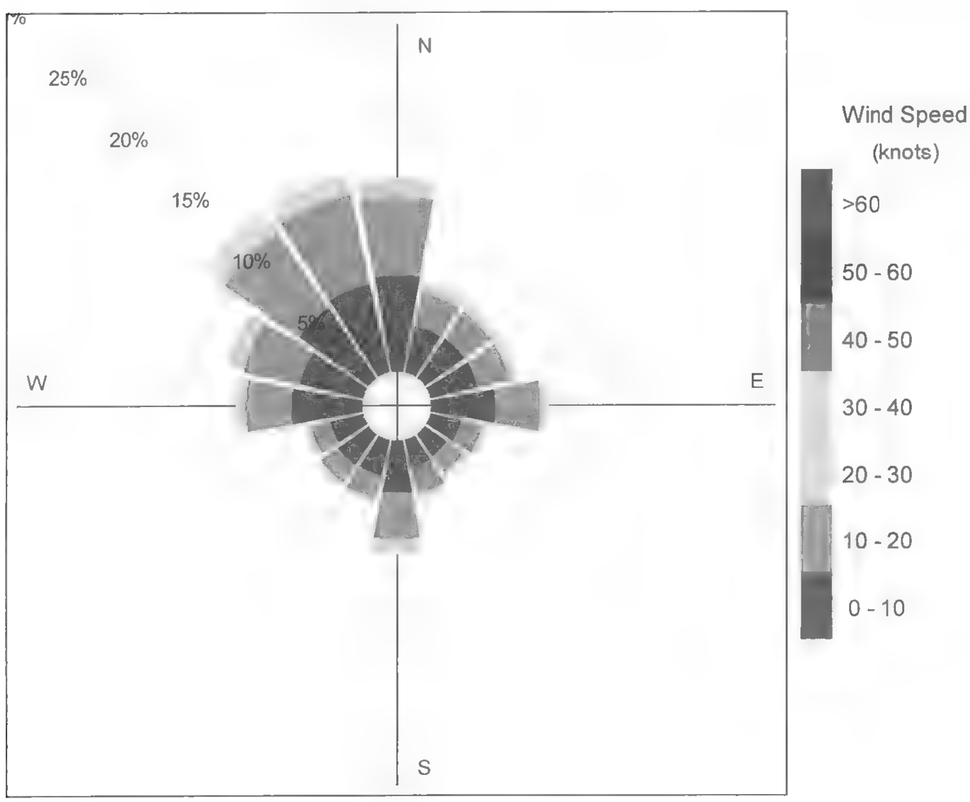

Figure 3.62 SAR Area 155 Spring Wind Rose Diagram (ISD)

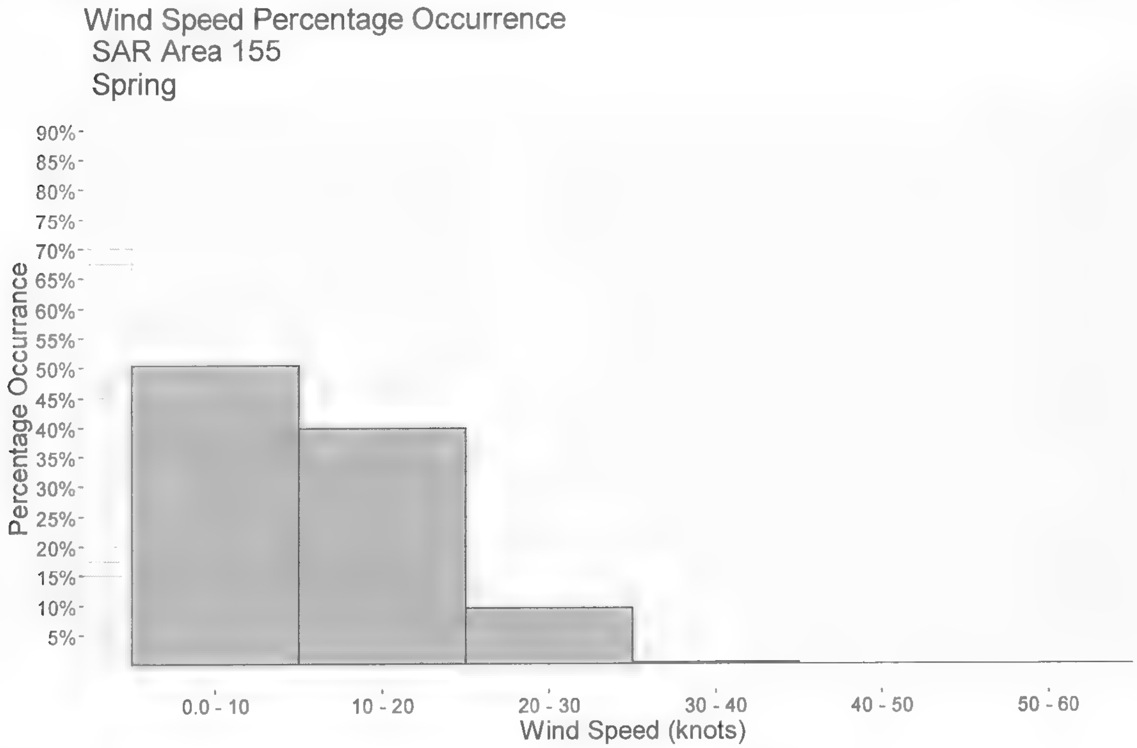

Figure 3.63 SAR Area 155 Spring Wind Speed Percentage Occurrence (ISD)

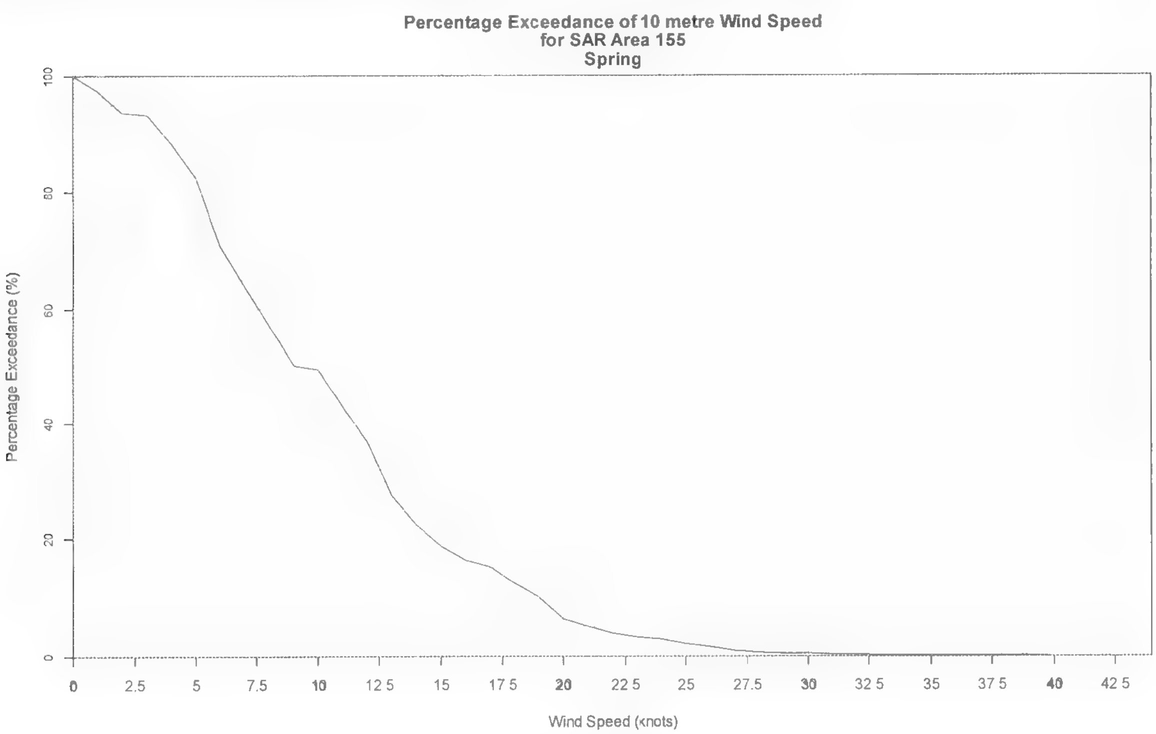

Figure 3.64 SAR Area 155 Spring Wind Speed Percentage Exceedance (ISD)

Table 3.35 SAR Area 155 Summer Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD Total Samples: 494751

Wind Speed (knots)	Wind Direction (true / from)																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	8.02	3.68	3.83	3.17	4.32	2.77	2.80	3.18	4.98	3.24	3.29	2.93	4.90	3.23	3.62	4.09	59.96
10 - 20	5.96	1.84	1.87	1.82	2.14	1.38	1.17	1.36	3.08	1.80	1.50	1.48	3.06	2.29	2.61	3.34	34.91
20 - 30	0.89	0.24	0.32	0.29	0.25	0.15	0.12	0.22	0.41	0.25	0.18	0.21	0.36	0.32	0.50	0.55	4.95
30 - 40	0.03	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.02	0.18
40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

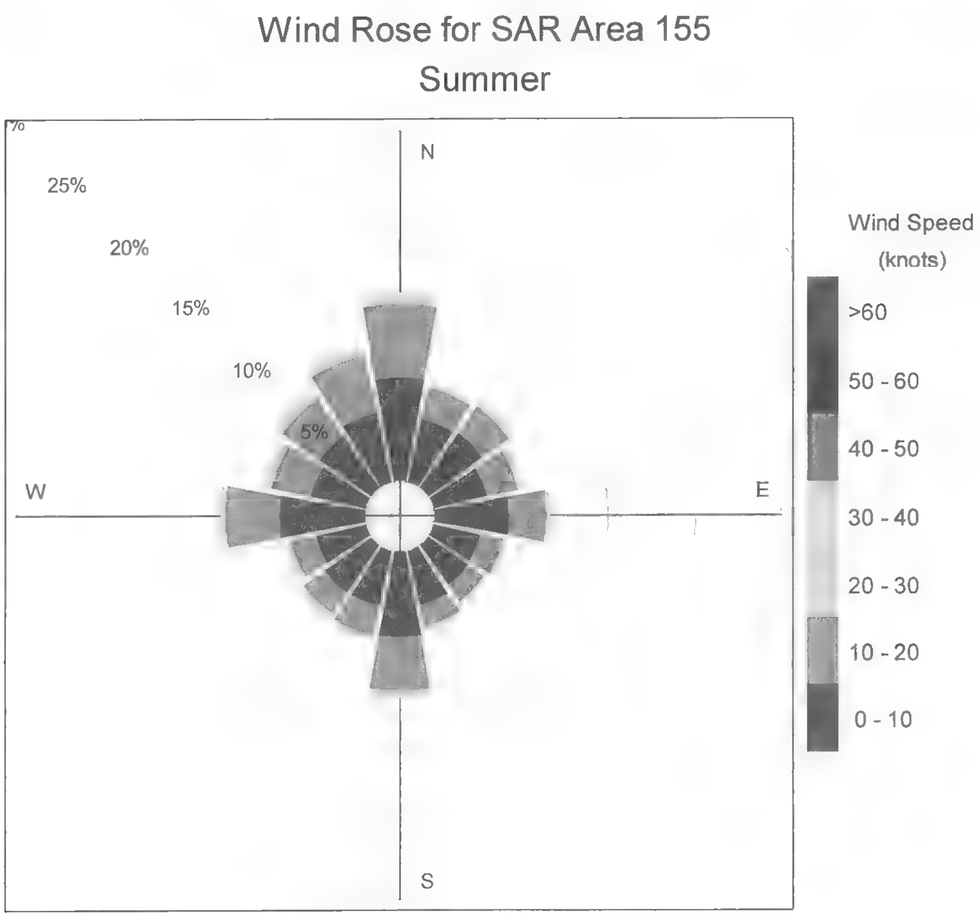

Figure 3.65 SAR Area 155 Summer Wind Rose Diagram (ISD)

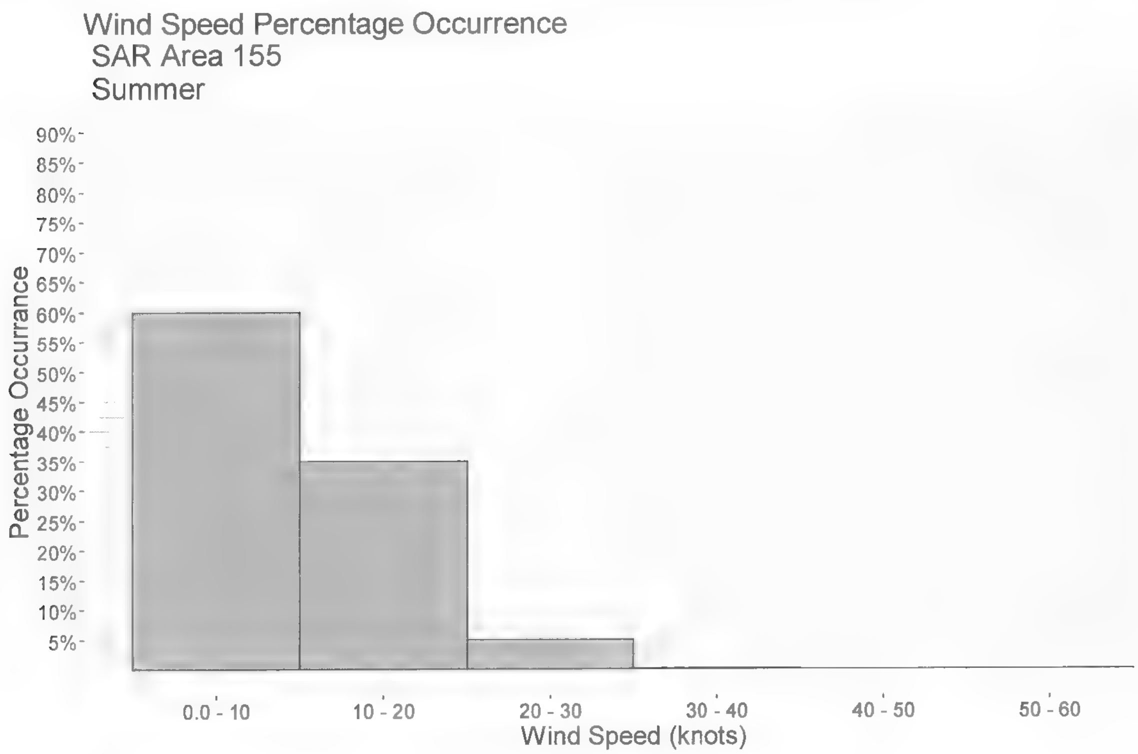

Figure 3.66 SAR Area 155 Summer Wind Speed Percentage Occurrence (ISD)

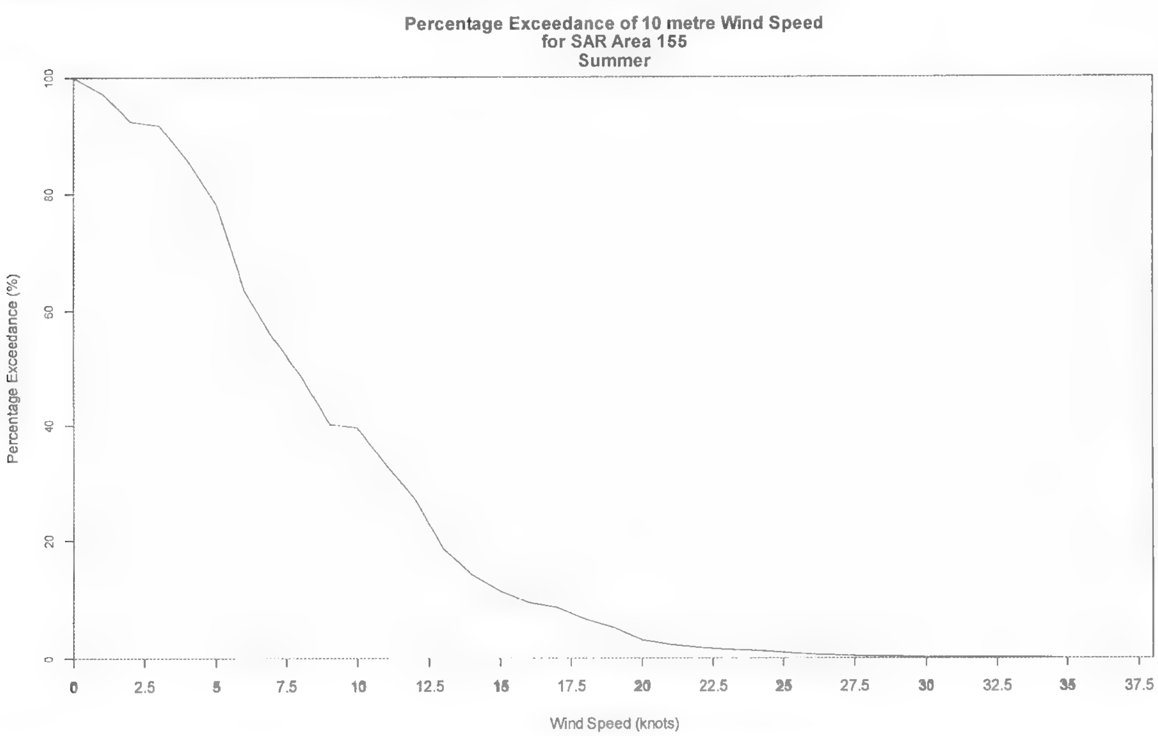

Figure 3.67 SAR Area 155 Summer Wind Speed Percentage Exceedance (ISD)

Table 3.36 SAR Area 155 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD | Total Samples: 536951

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	5.75	2.11	2.22	2.12	3.24	1.89	1.68	1.80	3.42	2.33	2.54	2.60	5.01	3.95	4.14	3.81	46.79
	10 - 20	5.91	1.73	1.70	1.70	2.29	1.40	1.17	1.42	2.78	1.79	1.75	1.72	3.68	3.74	4.72	4.37	39.75
	20 - 30	1.99	0.62	0.58	0.59	0.67	0.35	0.40	0.48	0.87	0.49	0.52	0.58	1.00	1.05	1.51	1.50	12.47
	30 - 40	0.17	0.06	0.06	0.04	0.04	0.05	0.03	0.03	0.05	0.02	0.03	0.03	0.04	0.06	0.15	0.11	0.92
	40 - 50	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.06
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

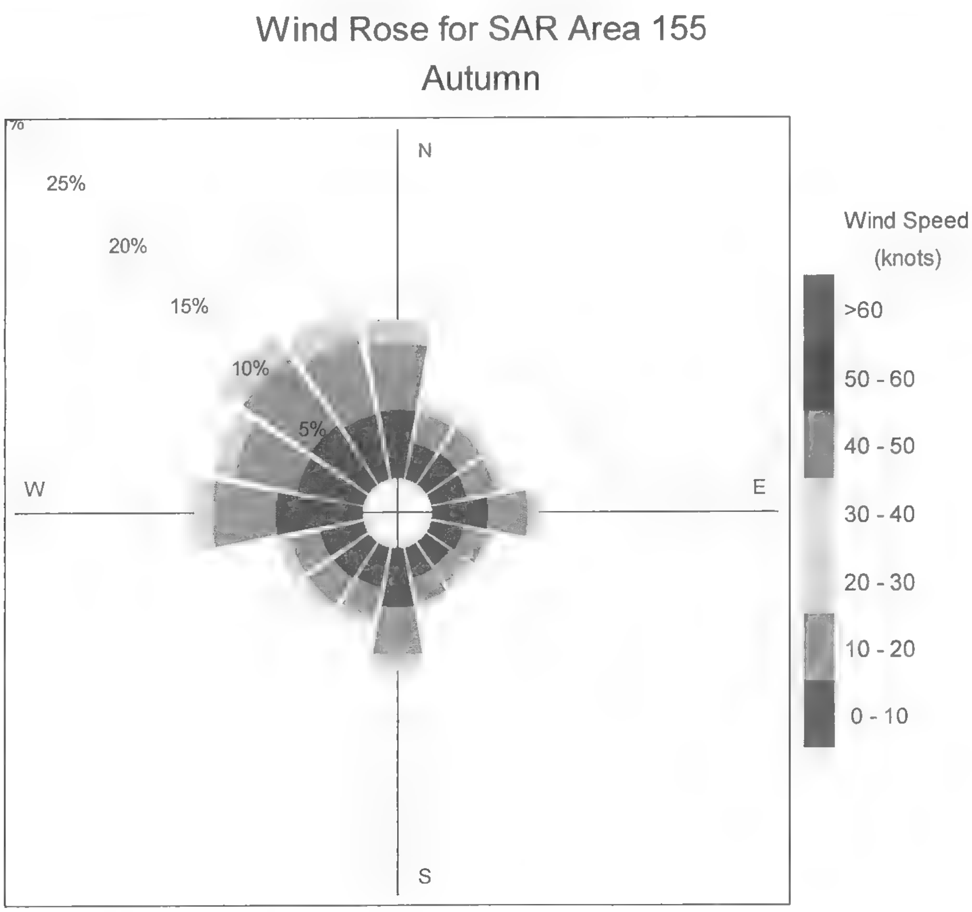

Figure 3.68 SAR Area 155 Autumn Wind Rose Diagram (ISD)

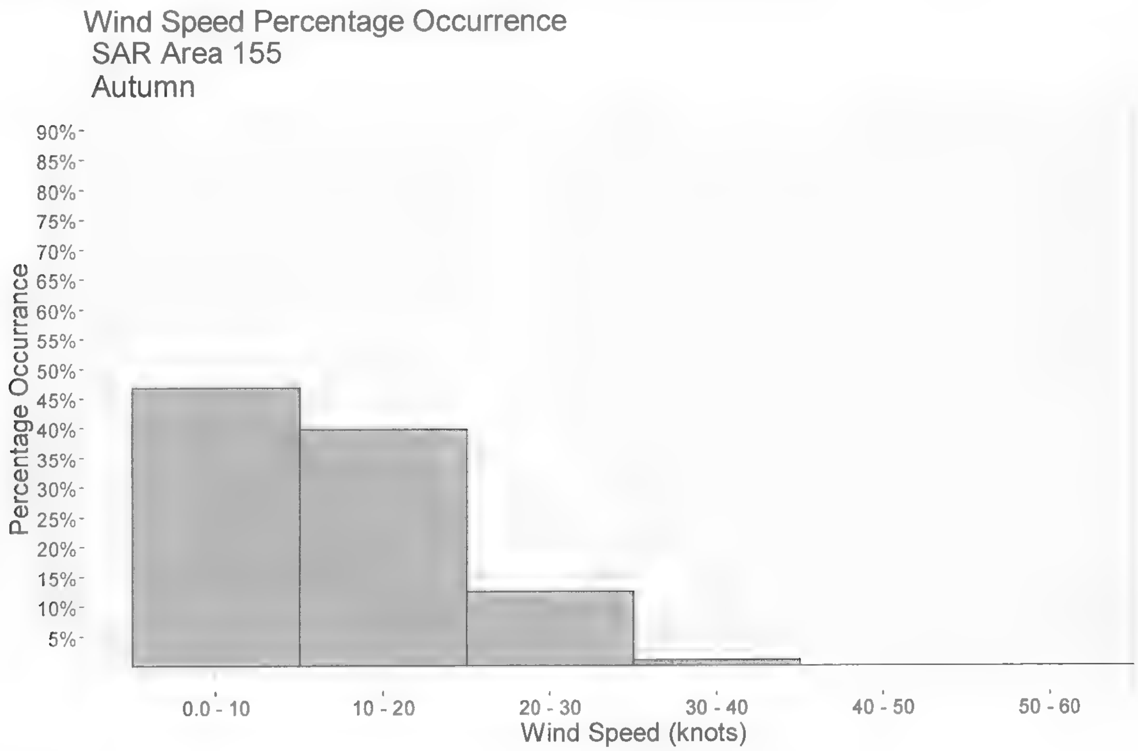

Figure 3.69 SAR Area 155 Autumn Wind Speed Percentage Occurrence (ISD)

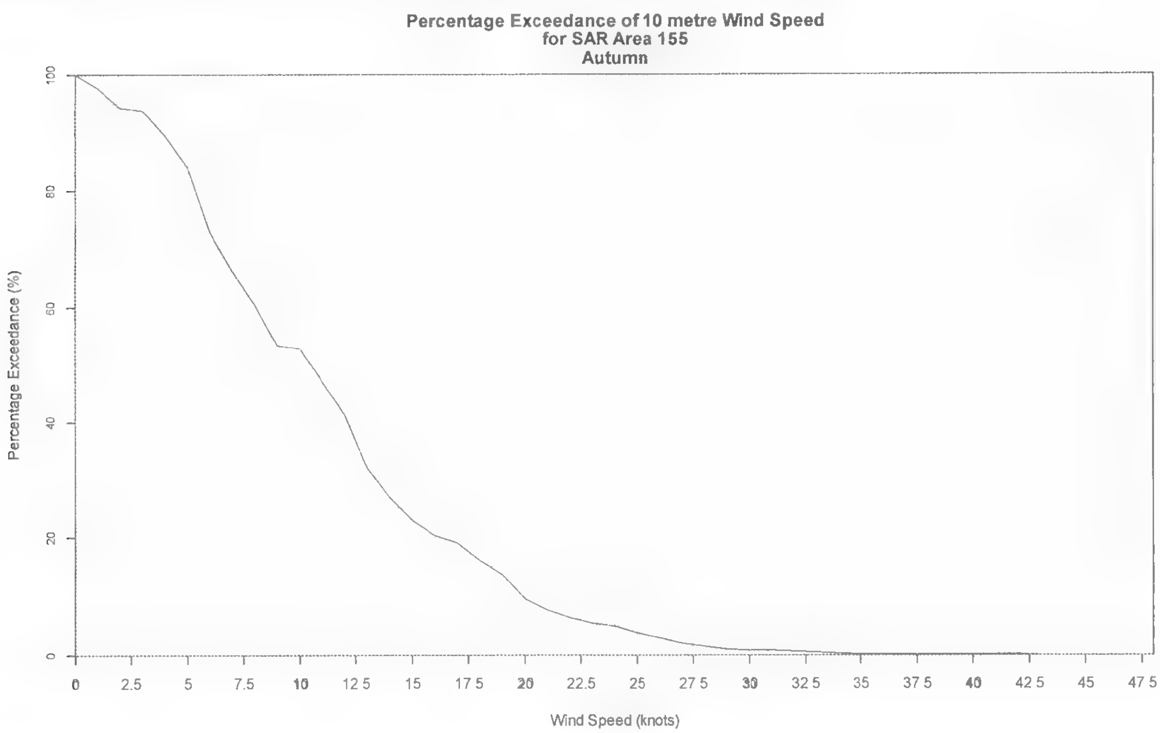

Figure 3.70 SAR Area 155 Autumn Wind Speed Percentage Exceedance (ISD)

3.2.2 Wave Height

Significant Wave Height

Seasonal mean, standard deviation, mean maximum and absolute maximum significant wave height statistics are provided in Table 3.37 for SAR Area 155.

There is insufficient directional data within the ICOADS wave data set to generate significant wave height wave roses or joint frequency of significant wave height and wave direction tables.

The associated histogram of the significant wave height frequency and the significant wave height percentage exceedance are presented in Figure 3.71 through Figure 3.78.

Table 3.37 SAR Area 155 Seasonal Significant Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.1	1.3	4.5	8.5
Spring	2.0	1.4	3.1	8.0
Summer	1.4	0.9	3.3	5.0
Autumn	1.9	1.2	5.2	7.3

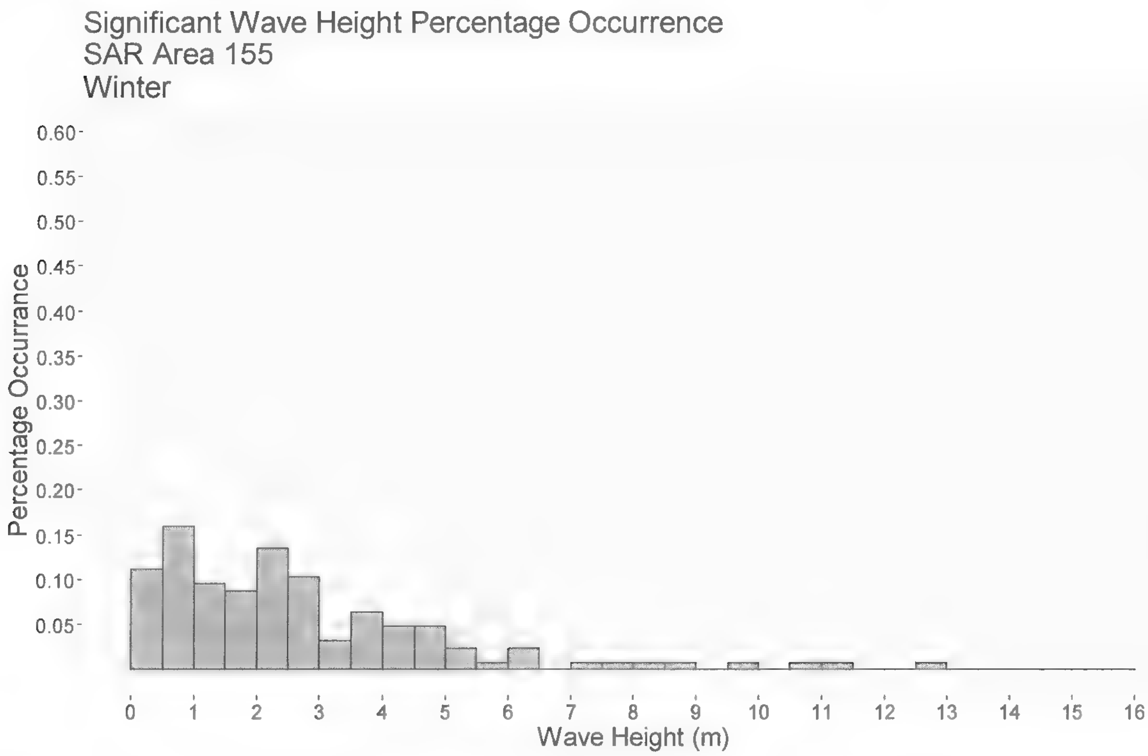

Figure 3.71 SAR Area 155 Winter Significant Wave Height Percentage Occurrence (ICOADS)

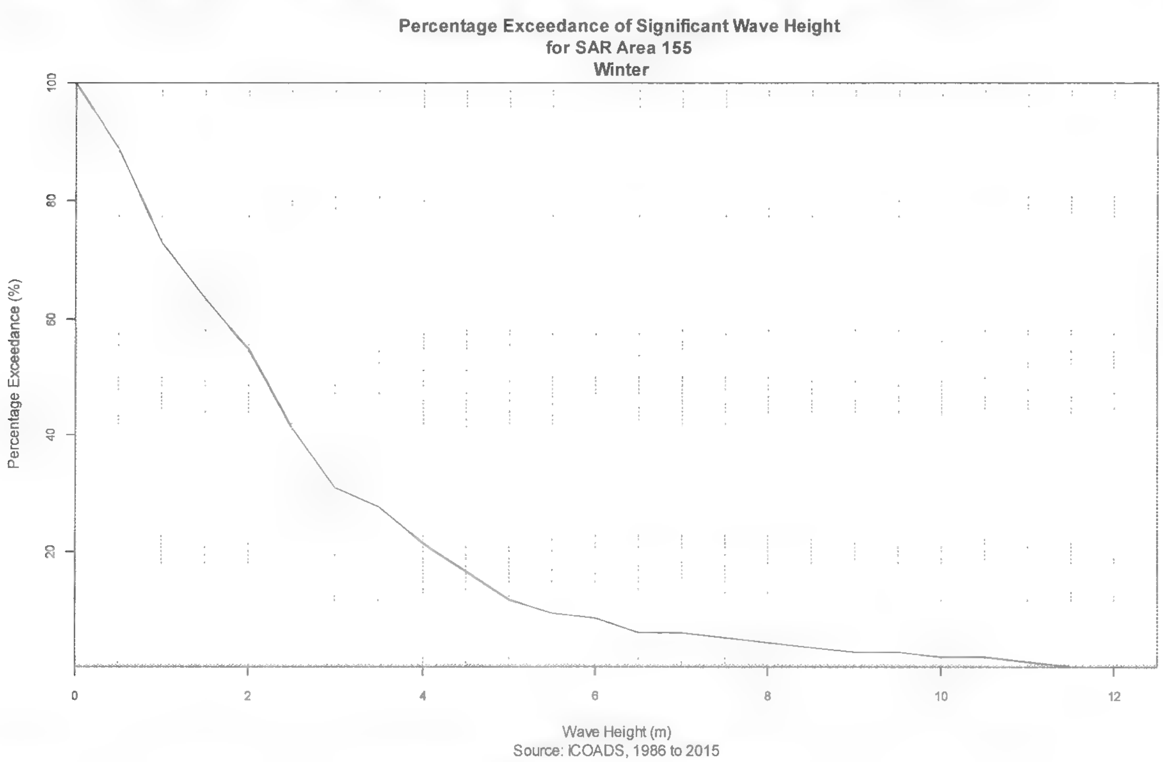

Figure 3.72 SAR Area 155 Winter Significant Wave Height Percentage Exceedance (ICOADS)

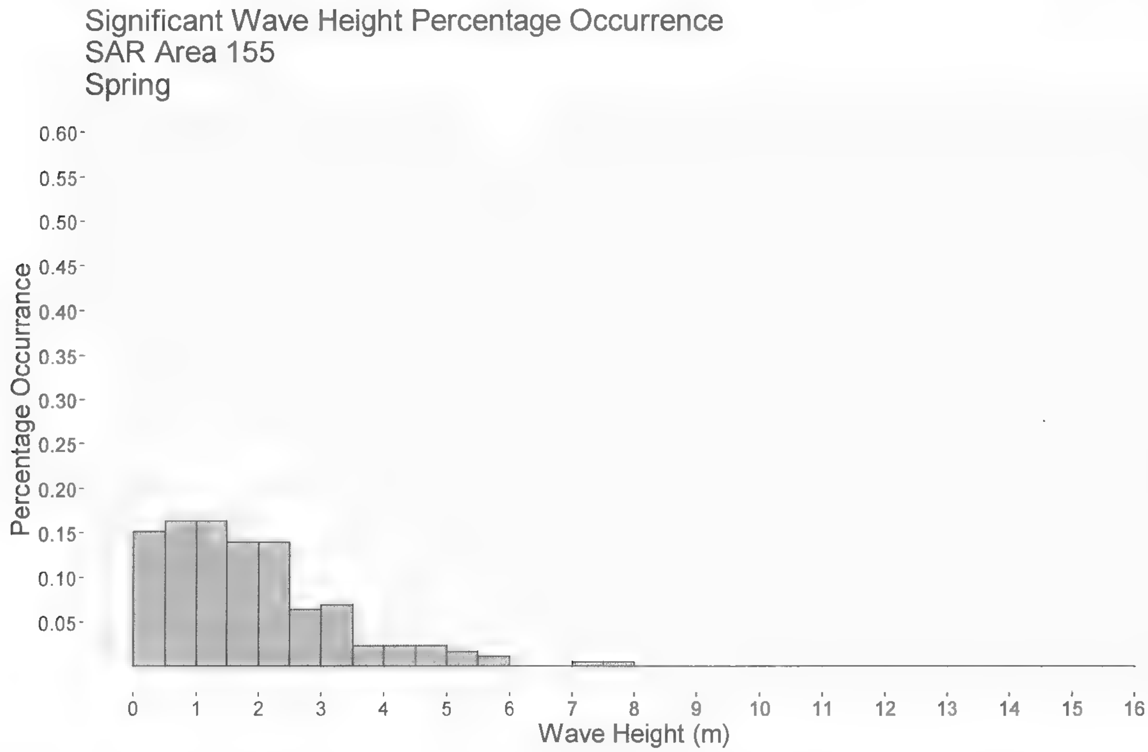

Figure 3.73 SAR Area 155 Spring Significant Wave Height Percentage Occurrence (ICOADS)

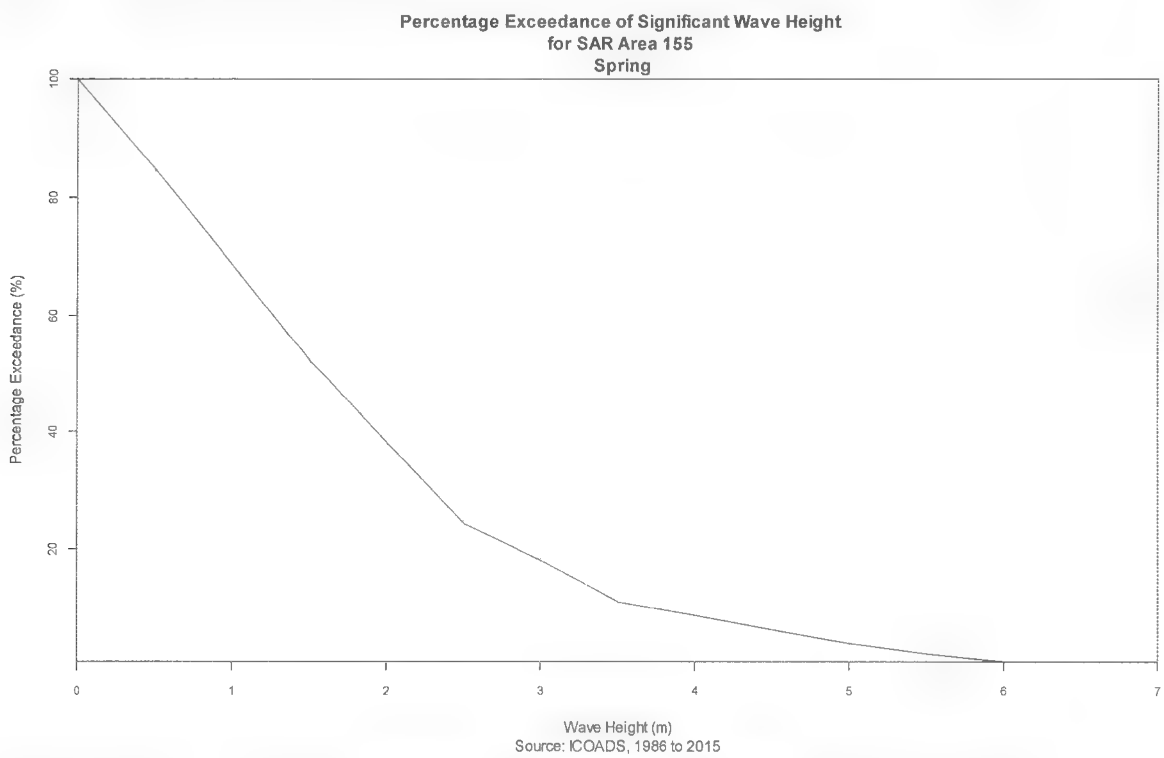

Figure 3.74 SAR Area 155 Spring Significant Wave Height Percentage Exceedance (ICOADS)

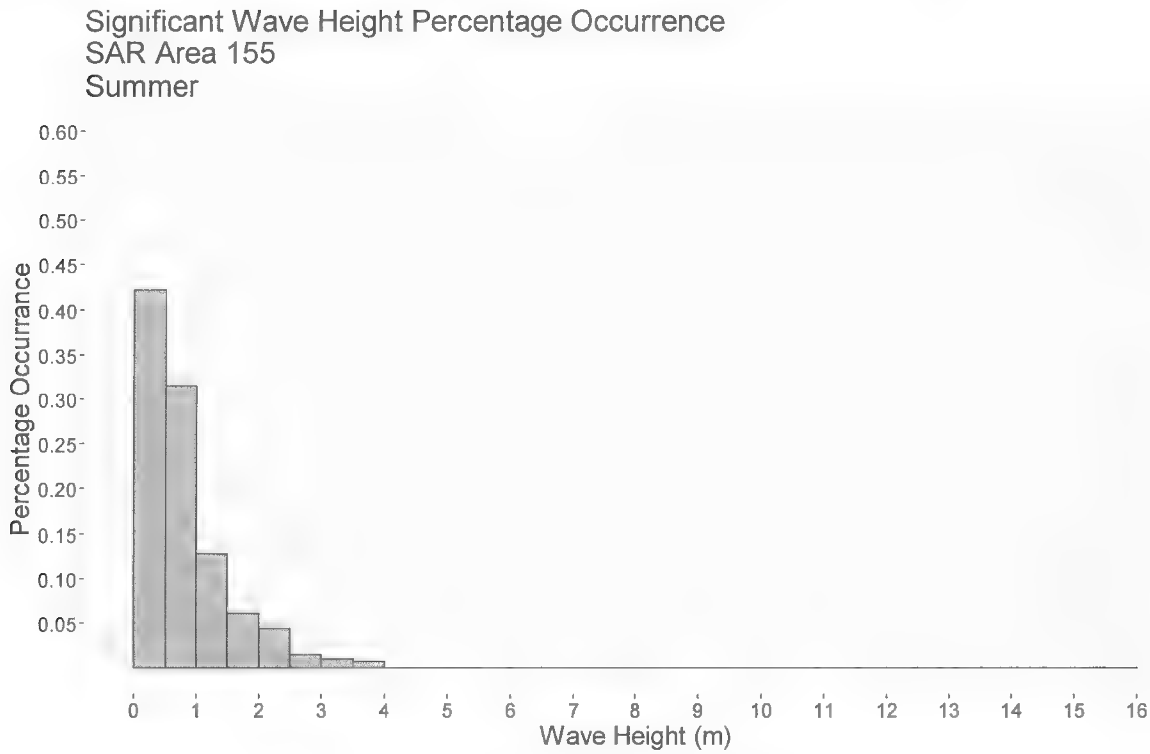

Figure 3.75 SAR Area 155 Summer Significant Wave Height Percentage Occurrence (ICOADS)

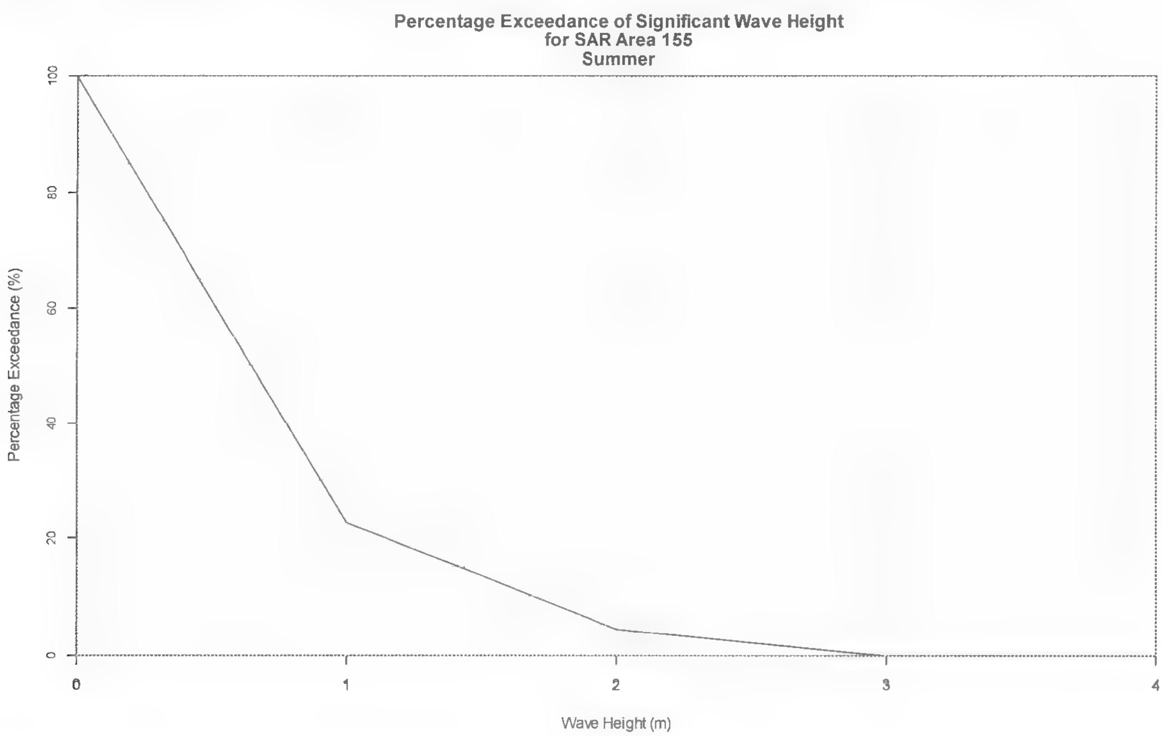

Figure 3.76 SAR Area 155 Summer Significant Wave Height Percentage Exceedance (ICOADS)

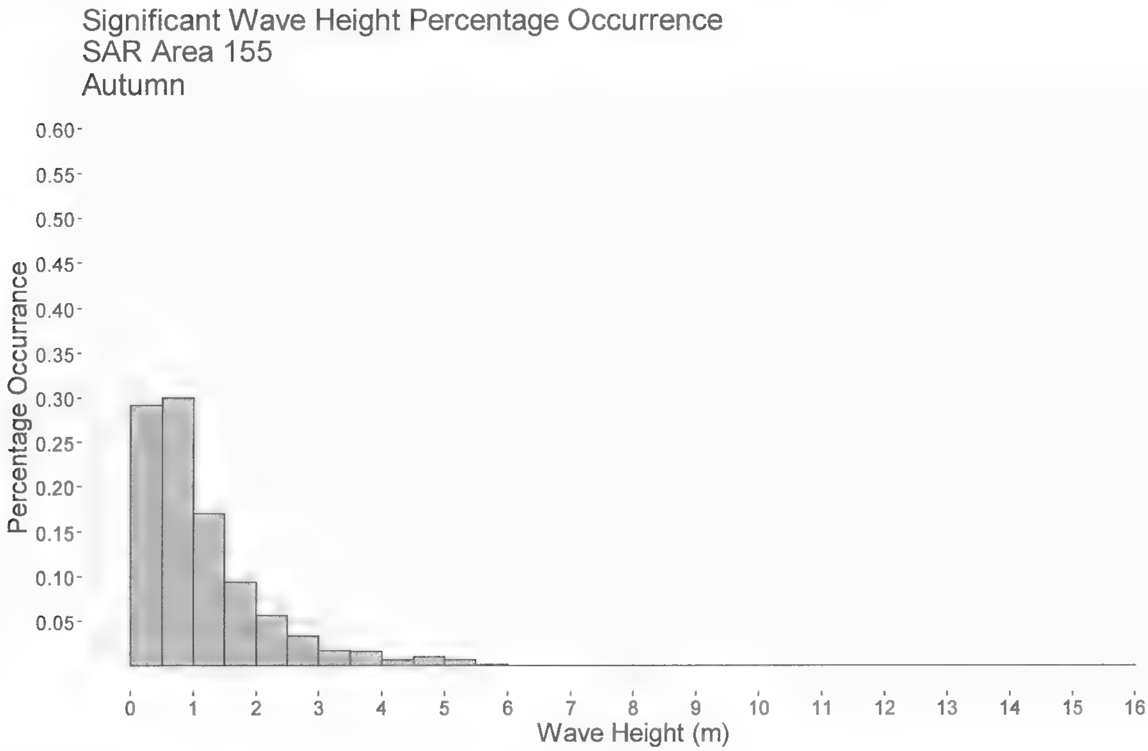

Figure 3.77 SAR Area 155 Autumn Significant Wave Height Percentage Occurrence (ICOADS)

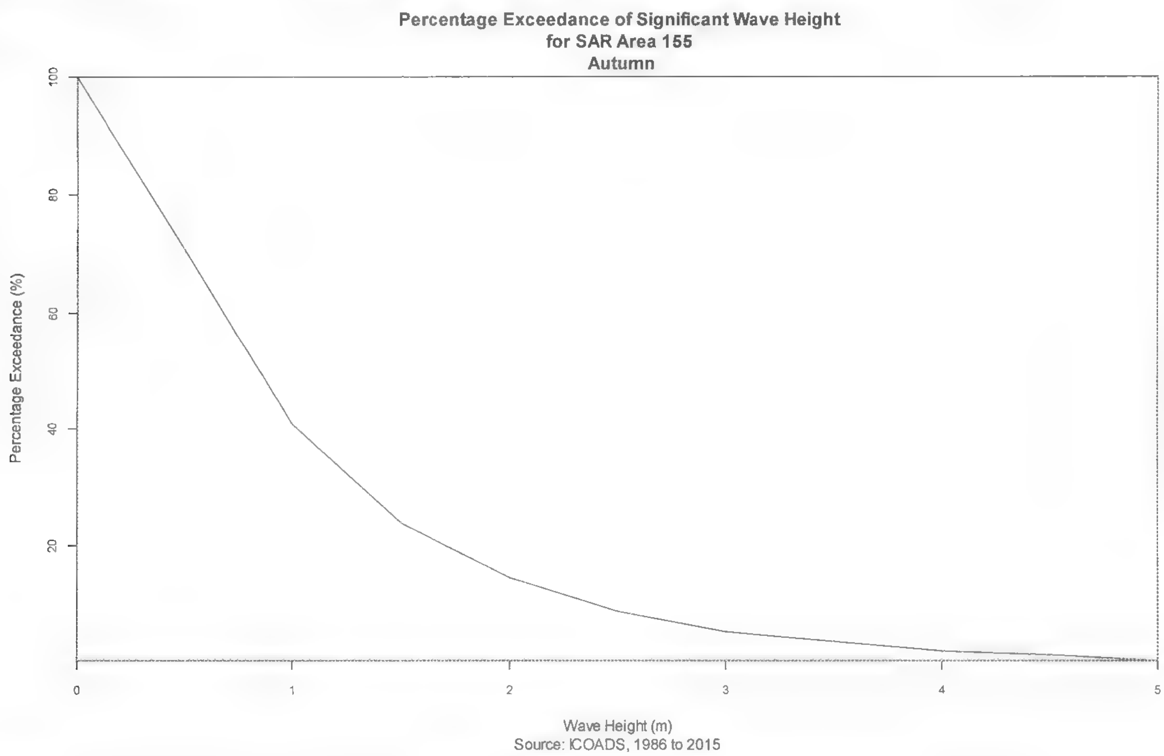

Figure 3.78 SAR Area 155 Autumn Significant Wave Height Percentage Exceedance (ICOADS)

Wind Wave Height

Seasonal mean, standard deviation, mean maximum and absolute maximum wind wave height statistics are provided in Table 3.38 for SAR Area 155.

There is insufficient directional data within the ICOADS wave data set to generate wind wave height wave roses or joint frequency of wind wave height and wave direction tables.

The associated histogram of the wind wave height frequency and the wind wave height percentage exceedance are presented in Figure 3.79 through Figure 3.86.

Table 3.38 SAR Area 155 Seasonal Wind Wave Height Statistics from MSC50 Grid Point 13408 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.4	2.2	4.1	11.5
Spring	1.5	1.1	3.1	6.0
Summer	1.0	0.6	2.7	3.5
Autumn	1.3	0.9	3.7	5.0

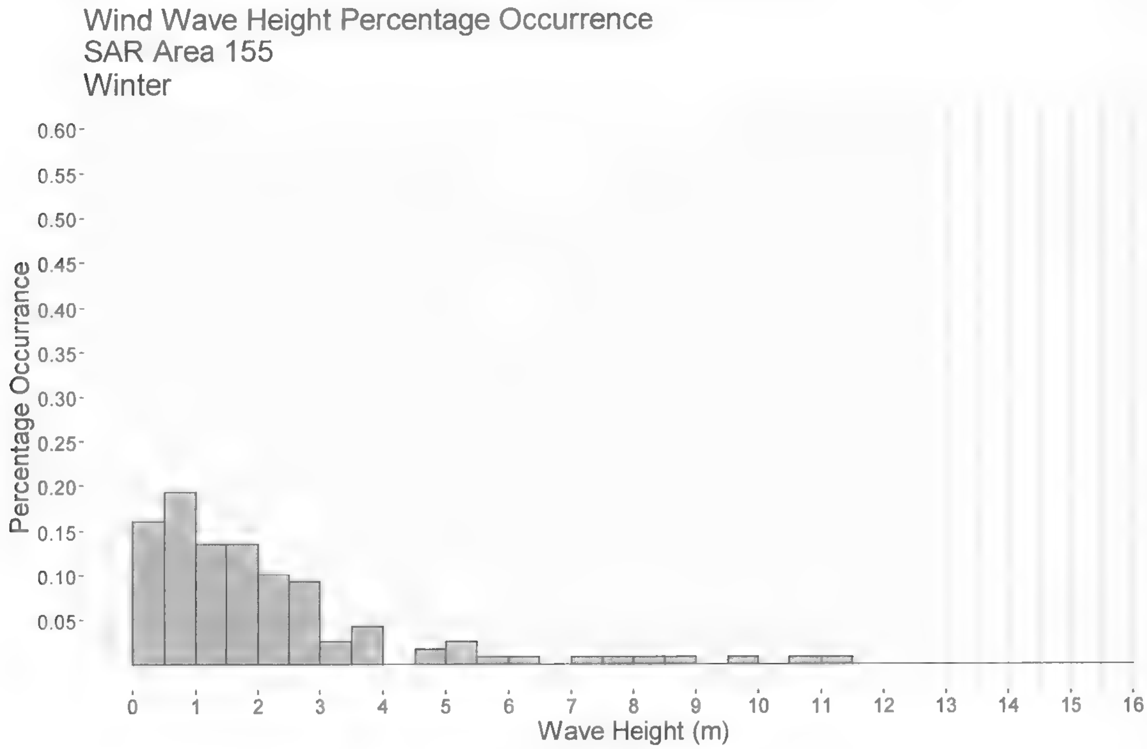

Figure 3.79 SAR Area 155 Winter Wind Wave Height Percentage Occurrence (Grid Point 13408)

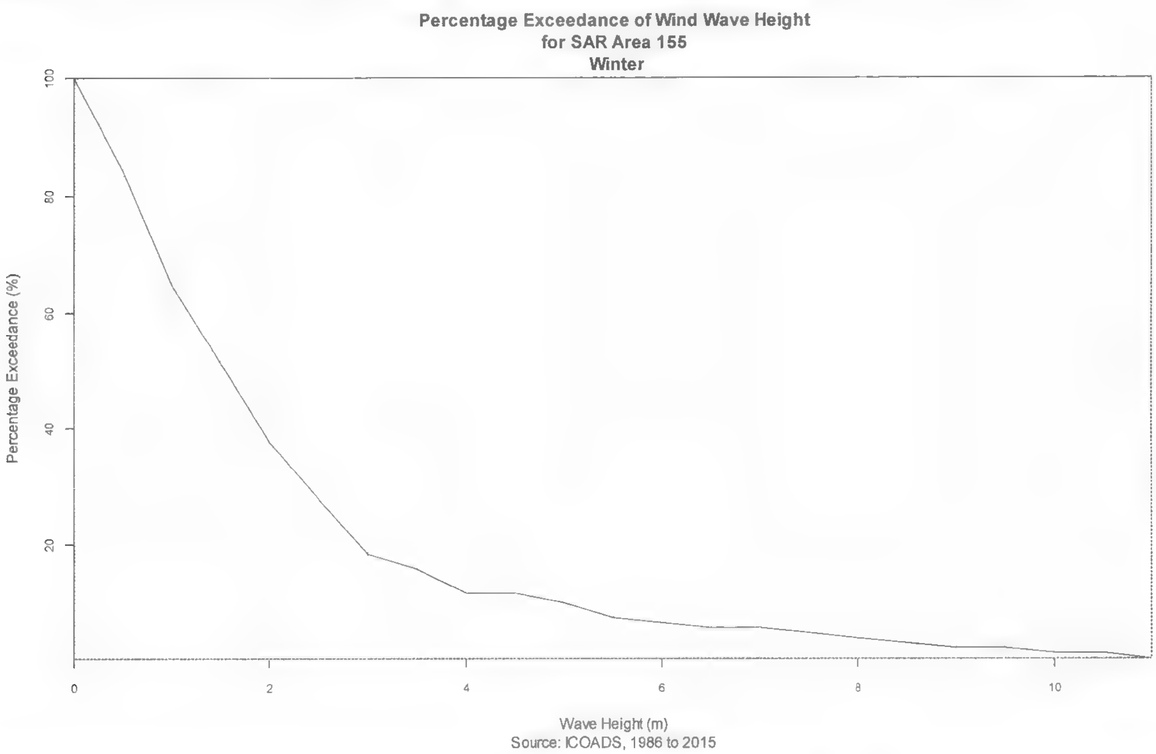

Figure 3.80 SAR Area 155 Winter Wind Wave Height Percentage Exceedance (Grid Point 13408)

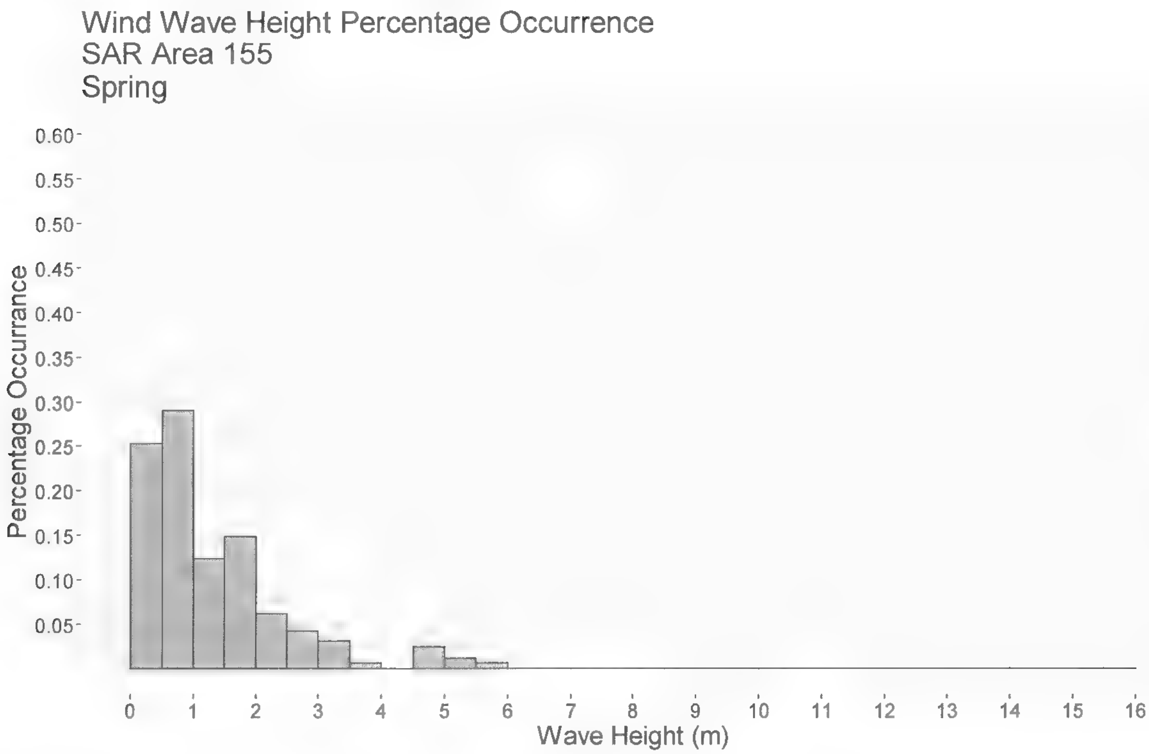

Figure 3.81 SAR Area 155 Spring Wind Wave Height Percentage Occurrence (Grid Point 13408)

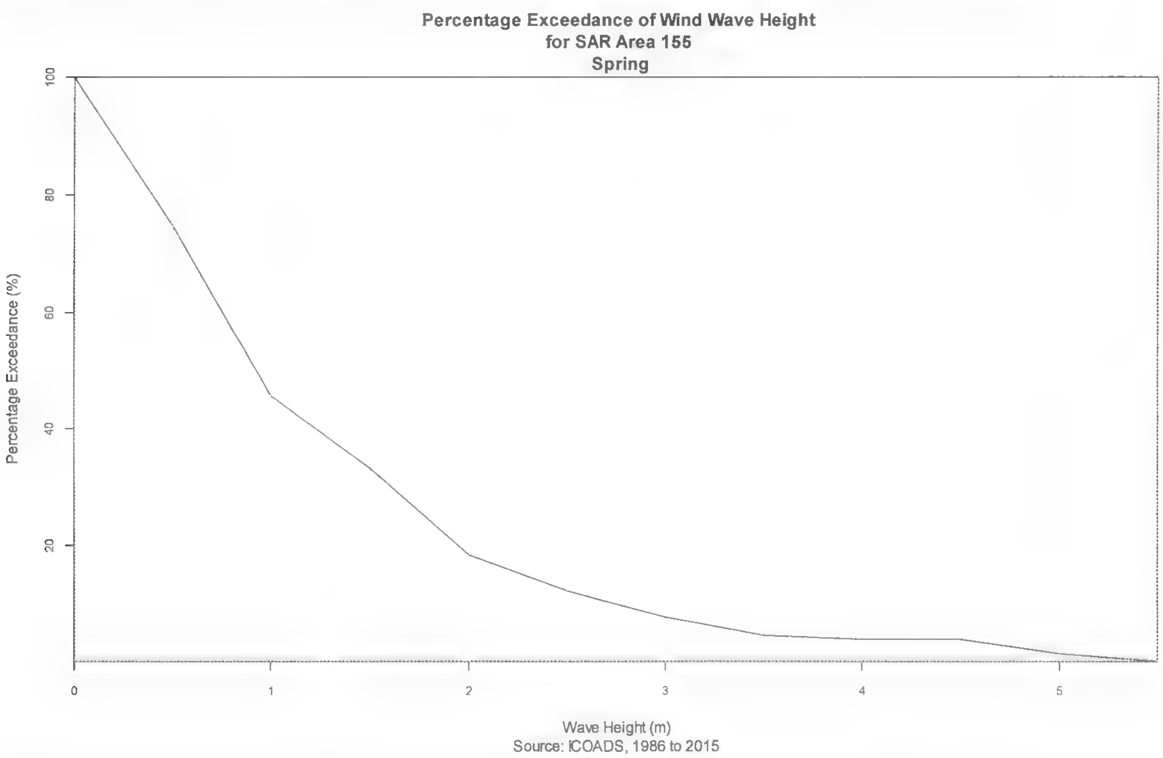

Figure 3.82 SAR Area 155 Spring Wind Wave Height Percentage Exceedance (Grid Point 13408)

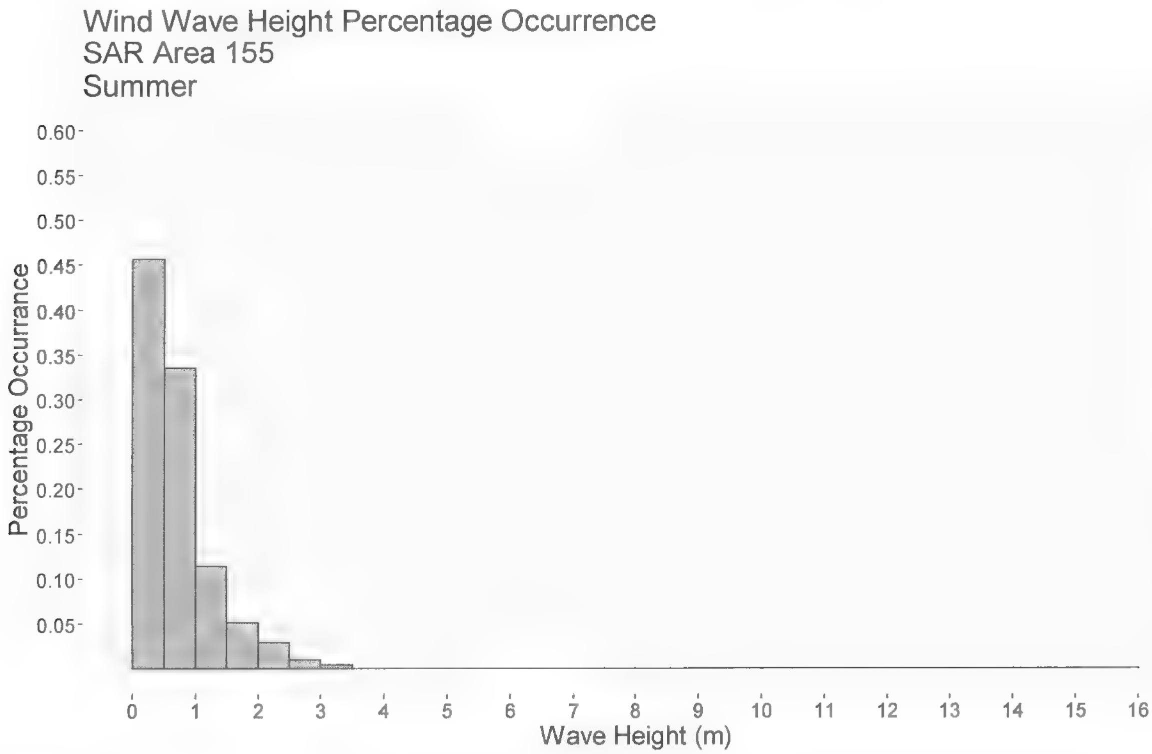

Figure 3.83 SAR Area 155 Summer Wind Wave Height Percentage Occurrence (Grid Point 13408)

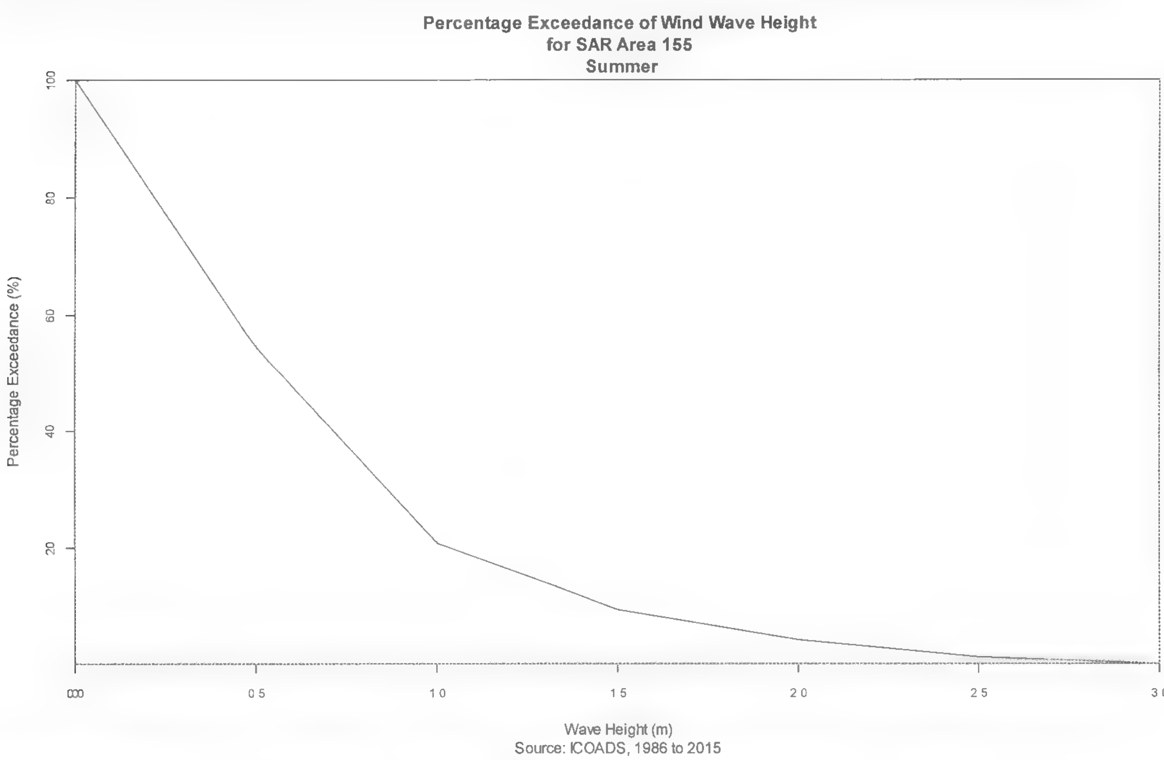

Figure 3.84 SAR Area 155 Summer Wind Wave Height Percentage Exceedance (Grid Point 13408)

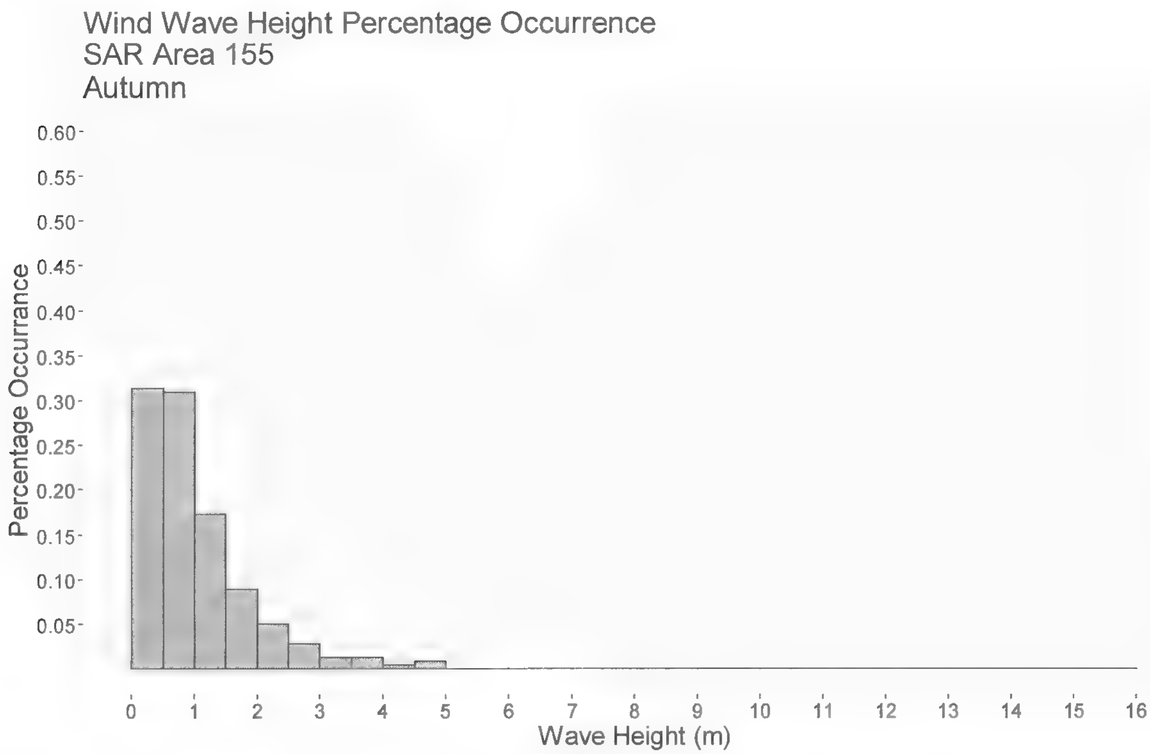

Figure 3.85 SAR Area 155 Autumn Wave Height Percentage Occurrence (Grid Point 13408)

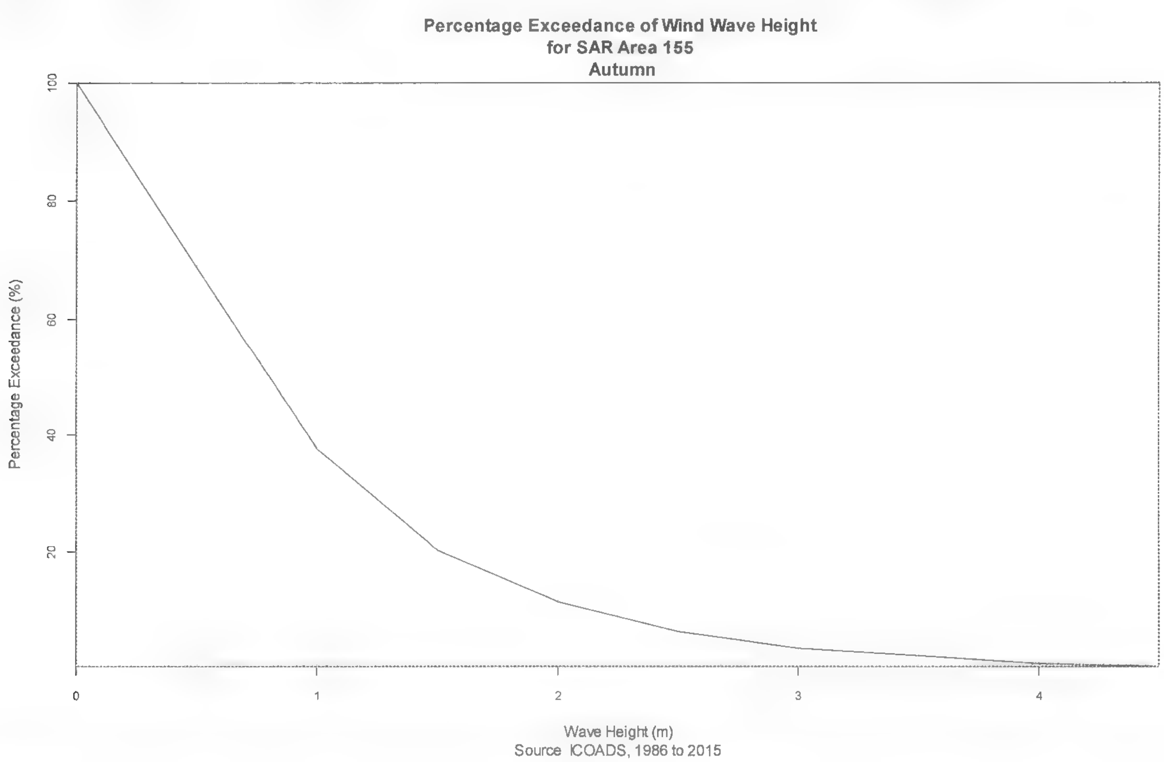

Figure 3.86 SAR Area 155 Autumn Wave Height Percentage Exceedance (Grid Point 13408)

Swell Height

Seasonal mean, standard deviation, mean maximum and absolute maximum swell height statistics are provided in Table 3.39 for SAR Area 155.

There is insufficient directional data within the ICOADS wave data set to generate swell height wave roses or joint frequency of swell height and direction tables.

The associated histogram of the swell wave height frequency and the swell wave height percentage exceedance are presented in Figure 3.87 through Figure 3.94.

Table 3.39 SAR Area 155 Seasonal Swell Height Statistics from MSC50 Grid Point 13408 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.4	1.3	3.1	6.0
Spring	1.9	1.2	3.0	7.0
Summer	1.4	0.9	2.5	5.5
Autumn	1.9	1.3	3.9	7.5

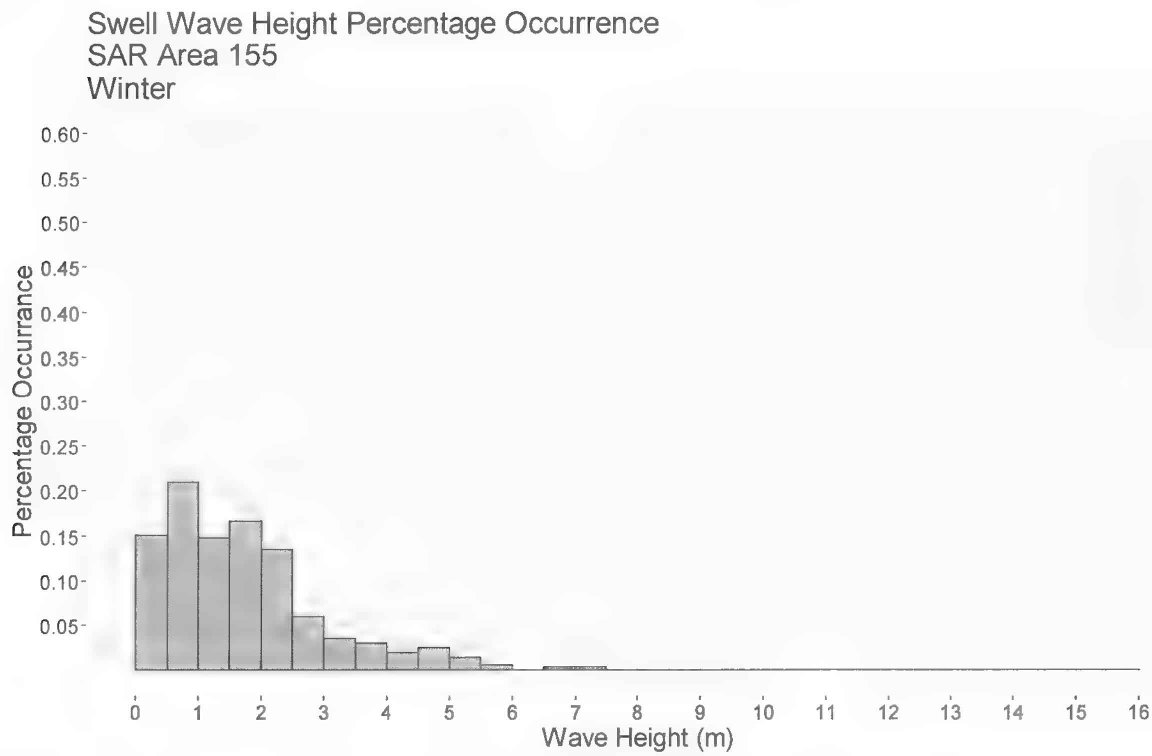

Figure 3.87 SAR Area 155 Winter Swell Height Percentage Occurrence (Grid Point 13408)

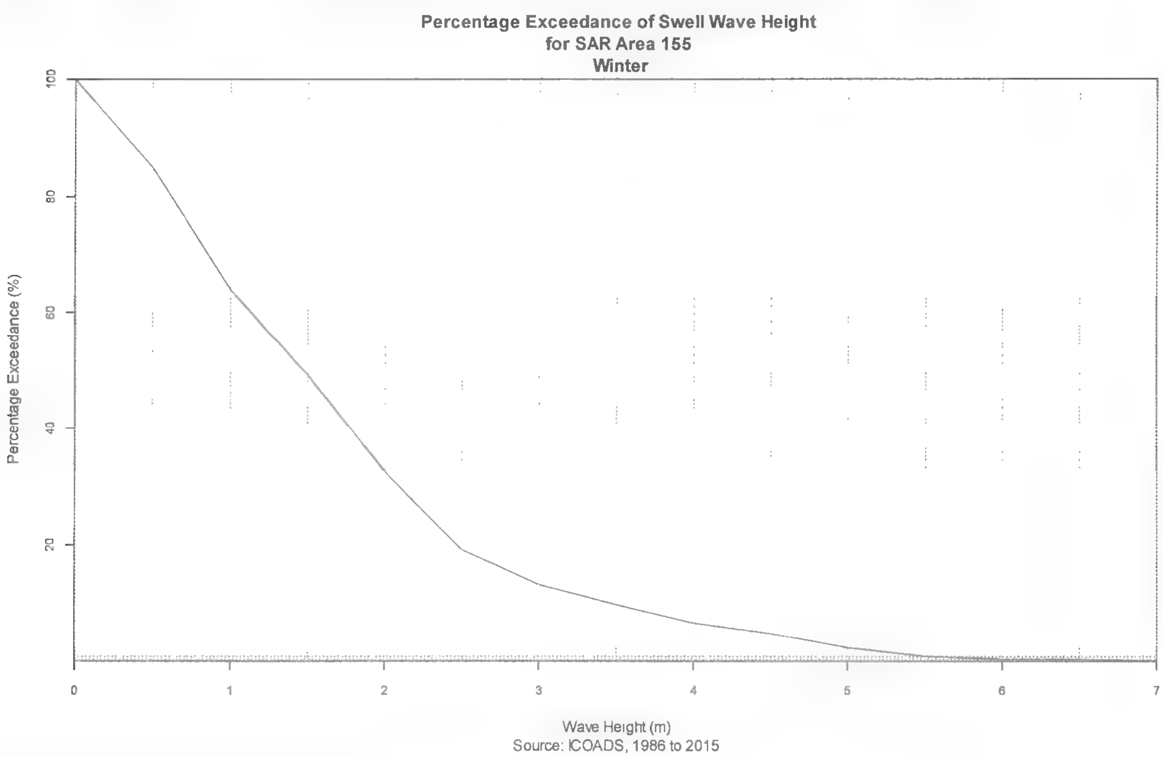

Figure 3.88 SAR Area 155 Winter Swell Height Percentage Exceedance (Grid Point 13408)

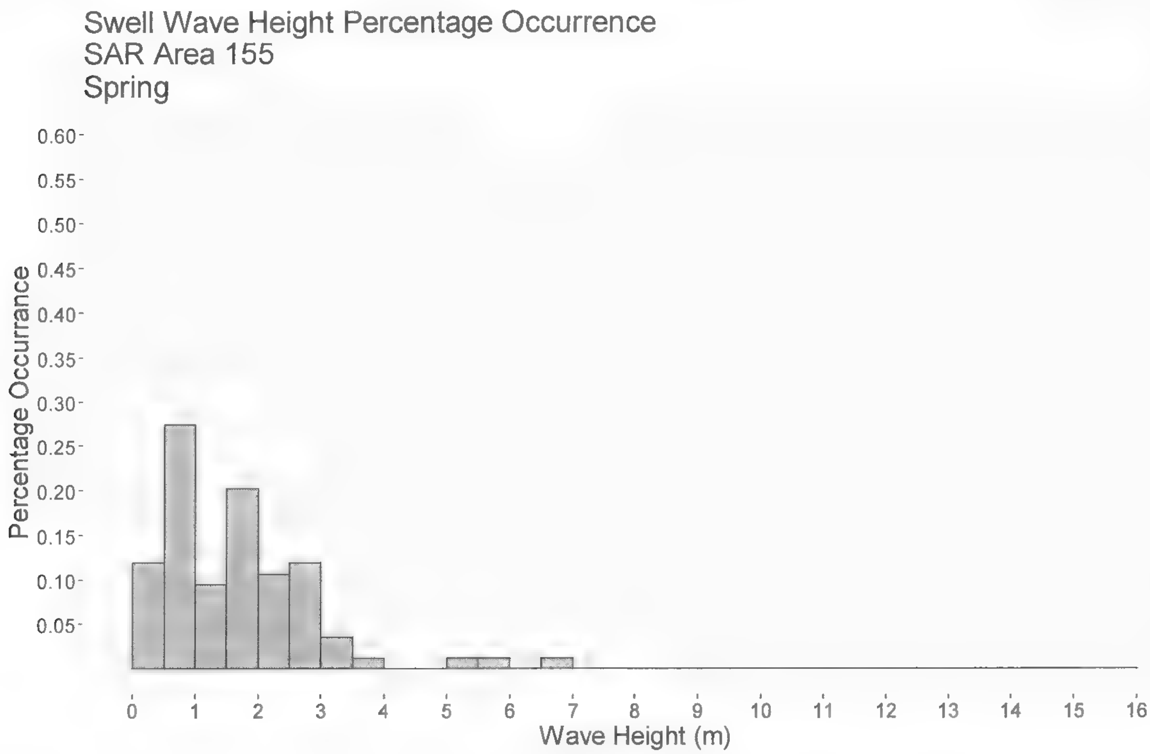

Figure 3.89 SAR Area 155 Spring Swell Height Percentage Occurrence (Grid Point 13408)

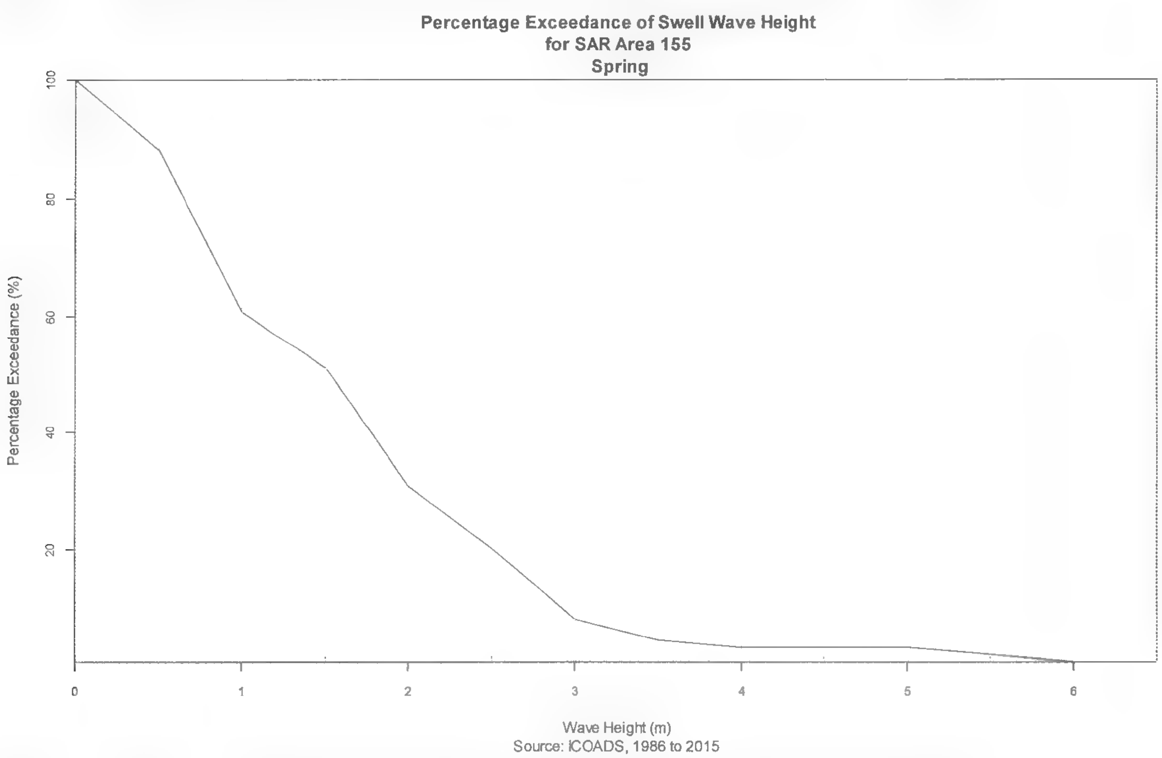

Figure 3.90 SAR Area 155 Spring Swell Height Percentage Exceedance (Grid Point 13408)

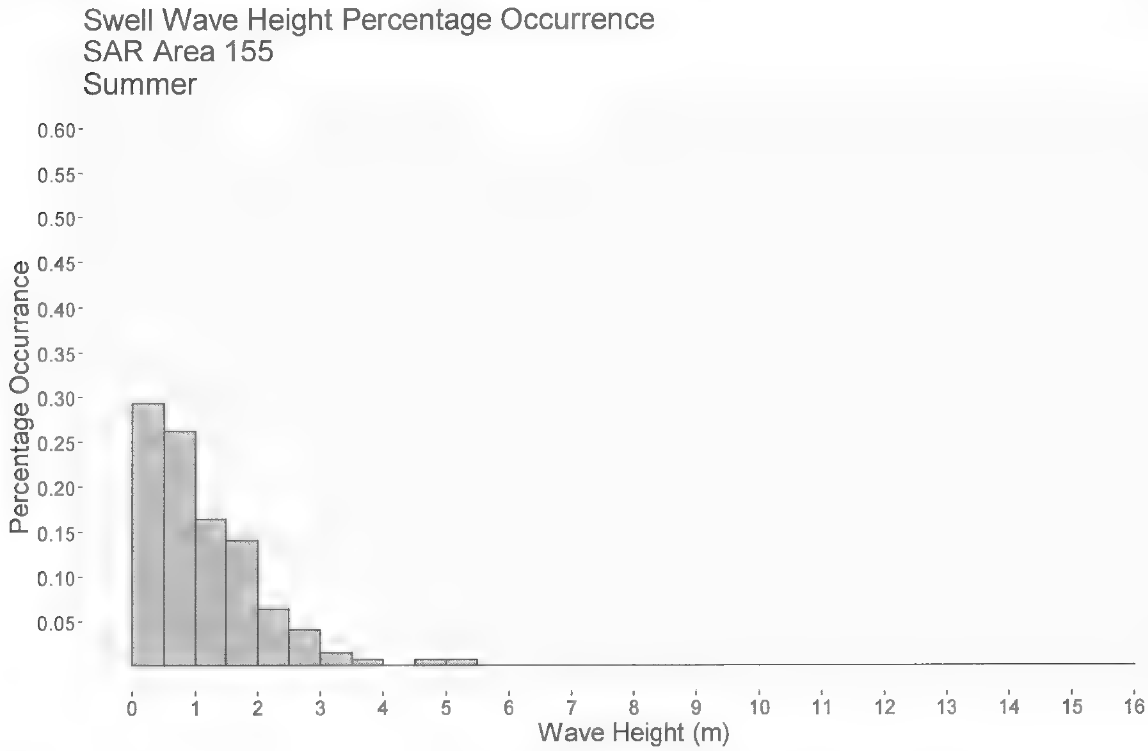

Figure 3.91 SAR Area 155 Summer Swell Height Percentage Occurrence (Grid Point 13408)

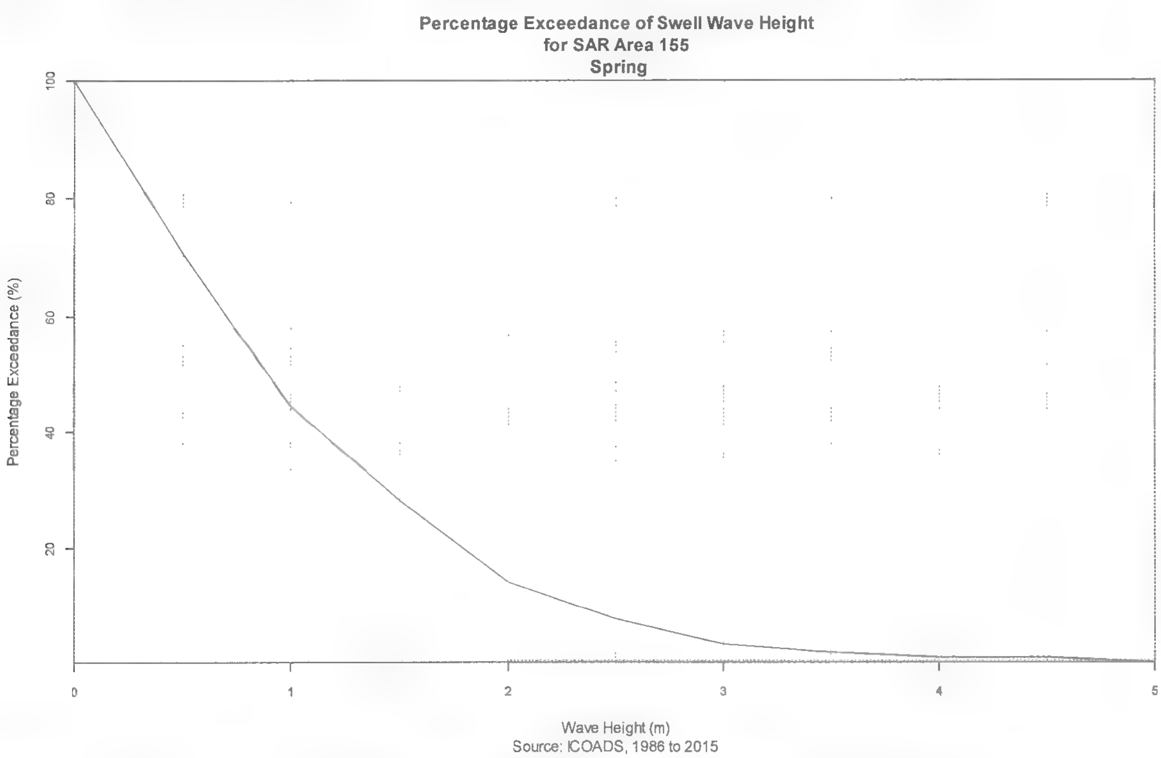

Figure 3.92 SAR Area 155 Summer Swell Height Percentage Exceedance (Grid Point 13408)

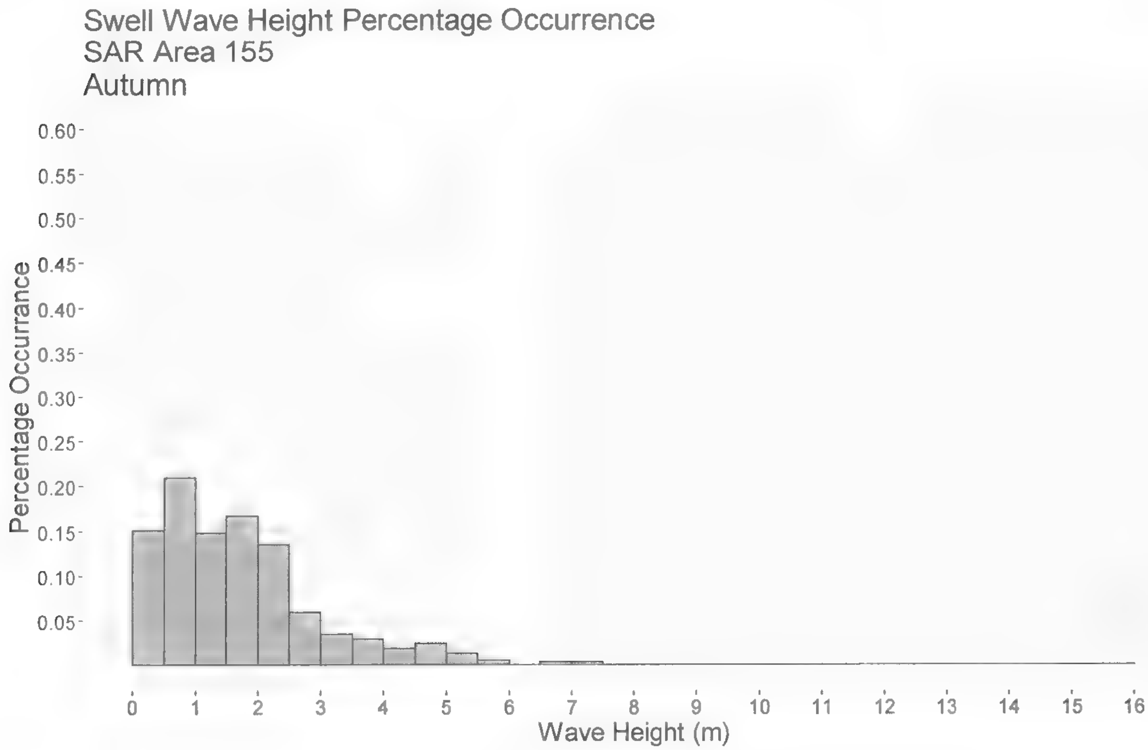

Figure 3.93 SAR Area 155 Autumn Swell Height Percentage Occurrence (Grid Point 13408)

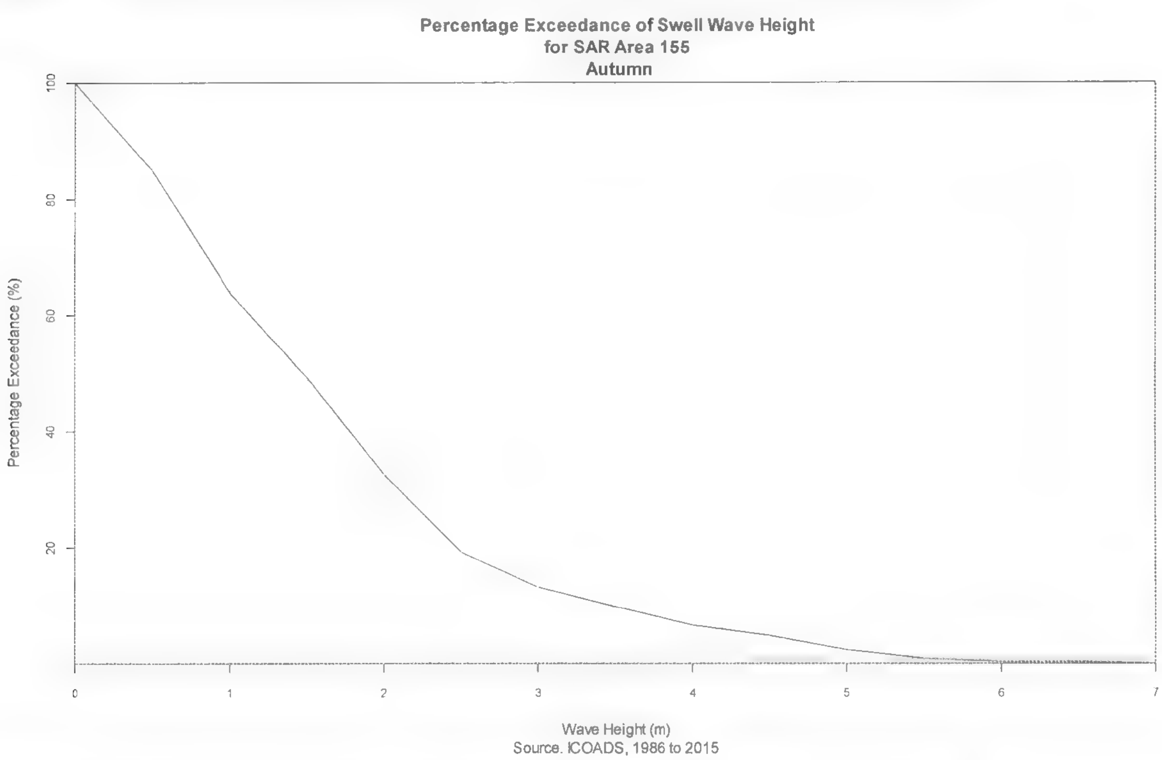

Figure 3.94 SAR Area 155 Autumn Swell Height Percentage Exceedance (Grid Point 13408)

3.2.3 *Air and Sea Surface Temperature*

Air temperatures for SAR Area 155 were extracted from the ISD data set while the ICOADS data set was used for the Sea Surface Temperatures. The ISD data was used due to insufficient observations of air temperature within the ICOADS data set. Seasonal plots of air temperature versus sea surface temperature are presented in Figure 3.95. Air and sea surface temperature statistics are presented in Table 3.40. The atmosphere is coldest in January with a mean seasonal air temperature of -24.6°C, and warmest during July with a mean seasonal air temperature of 10.9°C. Sea surface temperatures are warmest in August with a mean seasonal temperature of 7.4°C.

The mean maximum and mean minimum temperature statistics were calculated by determining the seasons maximum and minimum for each year, then averaging over the number of years of data. These statistics are presented in Table 3.41.

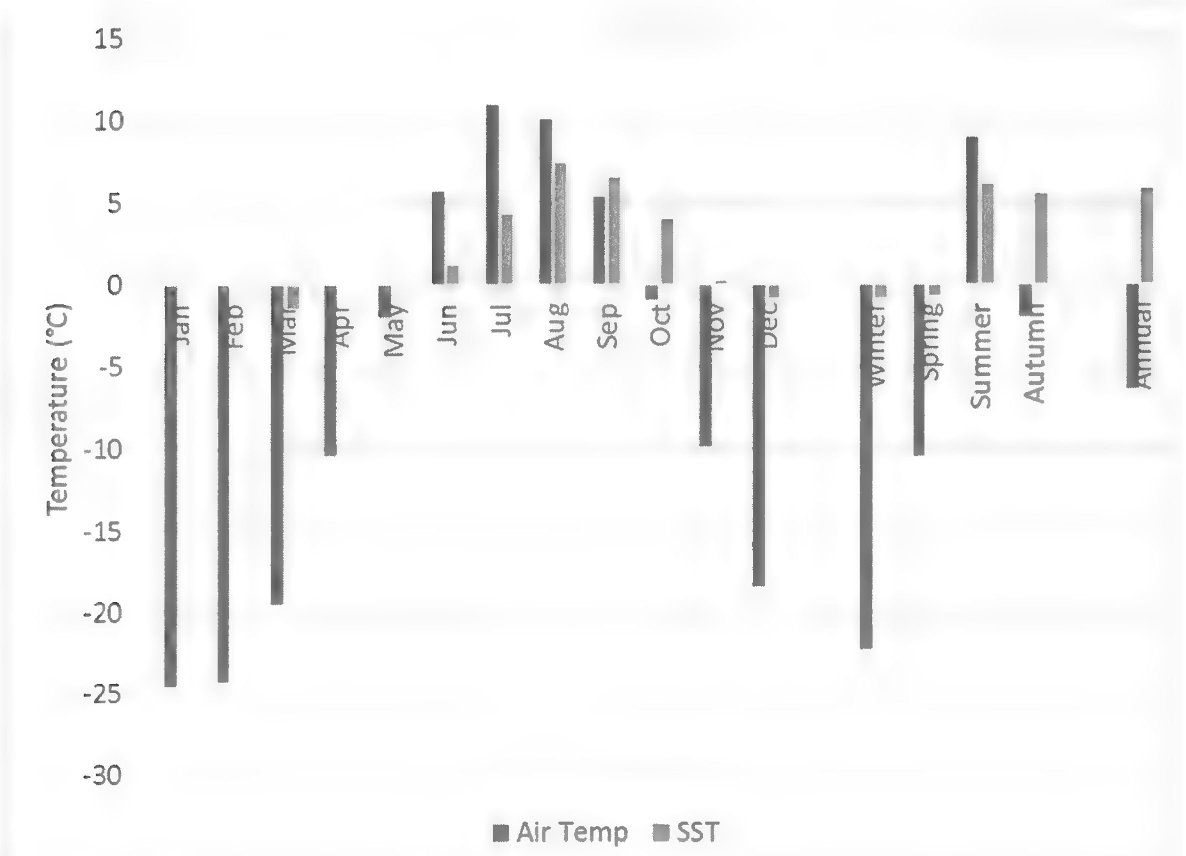

Figure 3.95 Monthly, Seasonal and Annual Mean Air and Sea Surface Temperature (°C) SAR Area 155 (ISD / ICOADS data set)

Table 3.40 Temperature (°C) Statistics for SAR Area 155

	Air Temperature (°C)				Sea Surface Temperature (°C)			
Month	Mean	Maximum	Minimum	Standard Deviation	Mean	Maximum	Minimum	Standard Deviation
January	-24.6	10.6	-47.0	9.2	NA	NA	NA	NA
February	-24.3	12.6	-51.1	9.2	NA	NA	NA	NA
March	-19.5	22.0	-48.1	10.1	NA	NA	NA	NA
April	-10.4	26.5	-38.0	8.9	NA	NA	NA	NA
May	-2.0	31.2	-29.0	7.4	NA	NA	NA	NA
June	5.6	34.7	-14.1	6.5	1.2	4.1	-1.3	1.2
July	10.9	36.0	-3.4	5.7	4.3	12.2	-1.2	2.7
August	10.0	33.0	-3.0	5.2	7.4	13.8	-0.8	3.1
September	5.3	29.1	-14.3	5.3	6.5	12.7	-1.3	3.1
October	-1.0	27.0	-29.0	6.3	4.0	11.0	-1.9	2.2
November	-9.9	17.0	-38.0	9.1	0.2	4.2	-1.2	1.0
December	-18.4	15.0	-46.0	9.7	-0.9	0.1	-1.4	0.3
Winter	-22.3	15.0	-51.1	9.8	-0.9	0.1	-1.4	0.3
Spring	-10.5	33.4	-48.1	11.4	NA	NA	NA	NA
Summer	8.9	37.0	-14.1	6.3	6.1	13.8	-1.3	3.4
Autumn	-2.0	31.0	-38.0	9.4	5.5	12.7	-1.9	3.1
Annual	-6.4	42.0	-51.1	14.7	5.8	13.8	-1.9	3.3

Table 3.41 Mean Maximum and Mean Minimum Temperature (°C) Statistics for SAR Area 155

	Air Temperature (°C)		Sea Surface Temperature (°C)	
Month	Mean Maximum	Mean Minimum	Mean Maximum	Minimum Standard Deviation
January	1.8	-43.0	NA	NA
February	3.0	-43.8	NA	NA
March	10.1	-42.7	NA	NA
April	17.7	-34.3	NA	NA
May	27.0	-23.5	NA	NA
June	30.2	-7.7	1.3	-0.3
July	31.5	-0.2	9.2	0.5
August	29.7	-0.9	10.8	1.1
September	26.3	-7.0	9.4	0.0
October	19.4	-21.8	6.4	0.8
November	10.9	-32.9	1.1	0.2
December	4.6	-40.0	-0.8	-1.0
Winter	6.9	-44.9	-0.8	-1.0
Spring	27.5	-42.7	NA	NA
Summer	32.5	-7.8	11.3	0.0
Autumn	26.5	-32.9	9.6	-0.6
Annual	33.0	-45.5	11.4	-0.9

3.2.4 Sea Ice

Frequency of Presence

A weekly analysis of the Canadian Ice Service's Frequency of Presence of Sea Ice for the period of 1981 to 2010 was determined for SAR Area 155. These results are presented in Table 3.42 and Figure 3.96. Charts were unavailable for weeks which show no data.

These statistics show that the region is affected by sea ice throughout the year. The Frequency of Presence is highest the week beginning April 02 (Figure 3.97).

It should be noted that there is an area of SAR Area 155 in the southern half of James Bay which is not covered by the Arctic Sea Ice charts. The statistics provided below are for the area of coverage.

Table 3.42 Frequency of Presence of Sea Ice within SAR Area 155 (1981 - 2010)

	Ice Free	1-15%	16-33%	34-50%	51-66%	67-84%	85-99%	100%
Jan-01	0.00	0.00	0.00	0.00	0.00	0.00	2.05	97.95
Jan-08								
Jan-15								
Jan-22								
Jan-29	0.00	0.00	0.00	0.00	0.00	0.00	0.29	99.70
Feb-05								
Feb-12								
Feb-19								
Feb-26	0.00	0.00	0.00	0.00	0.00	0.00	0.92	99.07
Mar-05								
Mar-12								
Mar-19								
Mar-26								
Apr-02	0.00	0.00	0.00	0.00	0.00	0.00	2.03	97.96
Apr-09								
Apr-16								
Apr-23								
Apr-30	0.00	0.00	0.00	0.00	0.03	1.36	21.90	76.71
May-07								
May-14	0.00	0.00	0.00	0.09	0.78	7.55	29.38	62.21
May-21								
May-28								
Jun-04	0.00	0.00	0.30	0.92	5.33	16.14	42.30	35.00
Jun-11	0.00	0.16	0.35	2.41	6.93	15.64	39.43	35.08
Jun-18	0.00	0.34	1.19	5.45	9.15	23.16	39.34	21.36
Jun-25	0.00	0.48	2.55	11.03	13.49	24.67	42.64	5.14
Jul-02	0.00	1.10	6.14	17.72	14.18	30.72	26.76	3.38
Jul-09	0.00	4.97	22.49	21.43	16.16	26.49	6.55	1.91
Jul-16	0.89	15.26	31.05	17.68	11.13	3.42	18.91	1.67
Jul-23	2.15	32.59	31.19	16.82	7.94	5.39	2.88	1.04
Jul-30	16.36	44.25	23.00	6.74	4.22	1.85	3.45	0.14
Aug-06	38.30	38.58	14.01	3.02	0.93	1.93	3.21	0.01
Aug-13	52.67	33.92	7.00	0.77	1.17	3.29	1.19	0.00
Aug-20	73.71	17.54	2.83	1.04	1.34	3.25	0.30	0.00
Aug-27	80.23	11.63	1.88	2.27	1.88	2.01	0.10	0.00
Sep-03	87.65	4.11	3.39	2.56	1.68	0.61	0.00	0.00
Sep-10	89.54	2.84	4.03	2.75	0.81	0.03	0.00	0.00

Sep-17	88.86	5.73	4.69	0.67	0.04	0.00	0.00	0.00
Sep-24	89.15	8.16	2.59	0.07	0.02	0.00	0.00	0.00
Oct-01	89.08	9.18	1.65	0.07	0.03	0.00	0.00	0.00
Oct-08	87.63	10.79	1.38	0.12	0.08	0.00	0.00	0.00
Oct-15	86.90	10.11	2.25	0.58	0.11	0.05	0.00	0.00
Oct-22	80.15	12.29	5.61	1.34	0.44	0.18	0.00	0.00
Oct-29	75.70	11.57	7.03	3.06	1.89	0.65	0.11	0.00
Nov-05	47.43	29.72	9.03	6.06	3.25	2.93	1.50	0.08
Nov-12	19.16	40.02	16.94	7.08	3.79	7.64	4.56	0.82
Nov-19	6.21	25.90	27.30	11.77	6.44	12.95	7.17	2.26
Nov-26	0.00	2.00	28.20	21.51	11.08	16.54	16.02	4.65
Dec-04	0.00	0.00	0.00	24.31	15.86	21.08	27.36	11.40

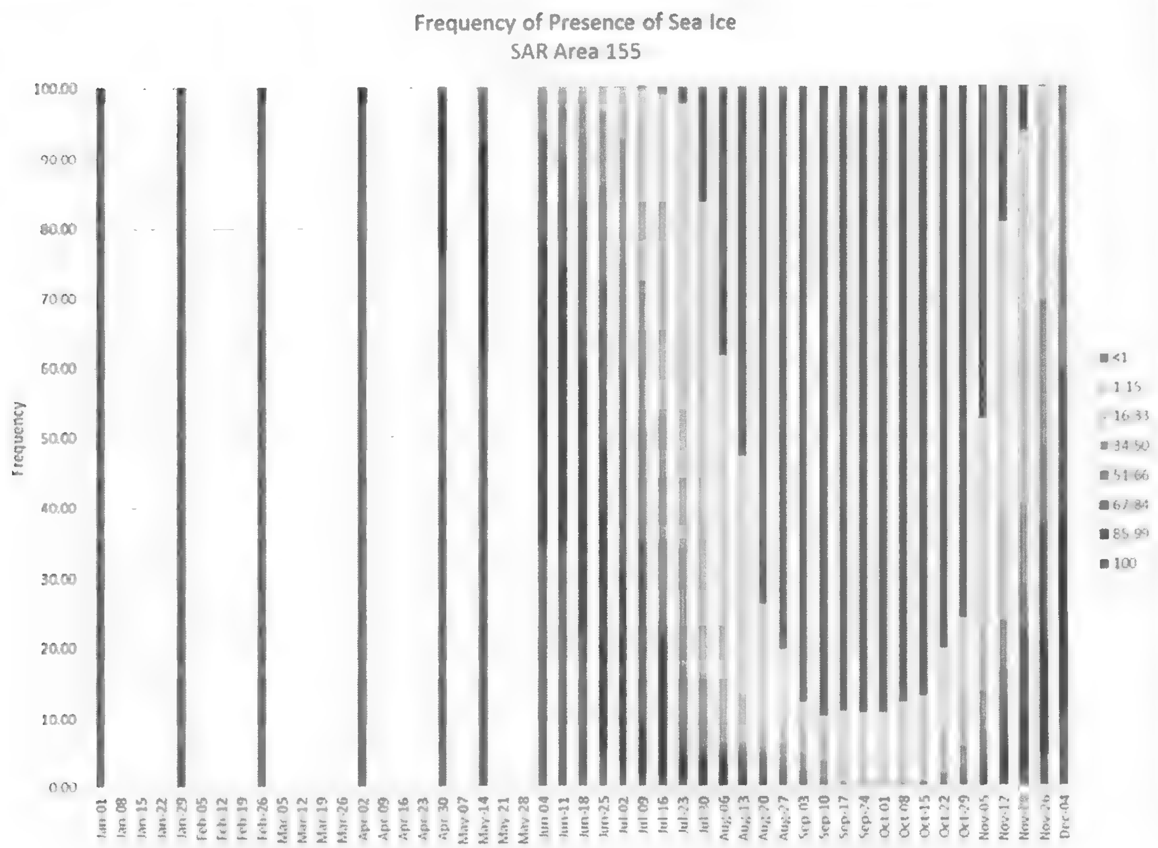

Figure 3.96 Plot of Frequency of Presence of Sea Ice within SAR Area 155 (1981 - 2010)

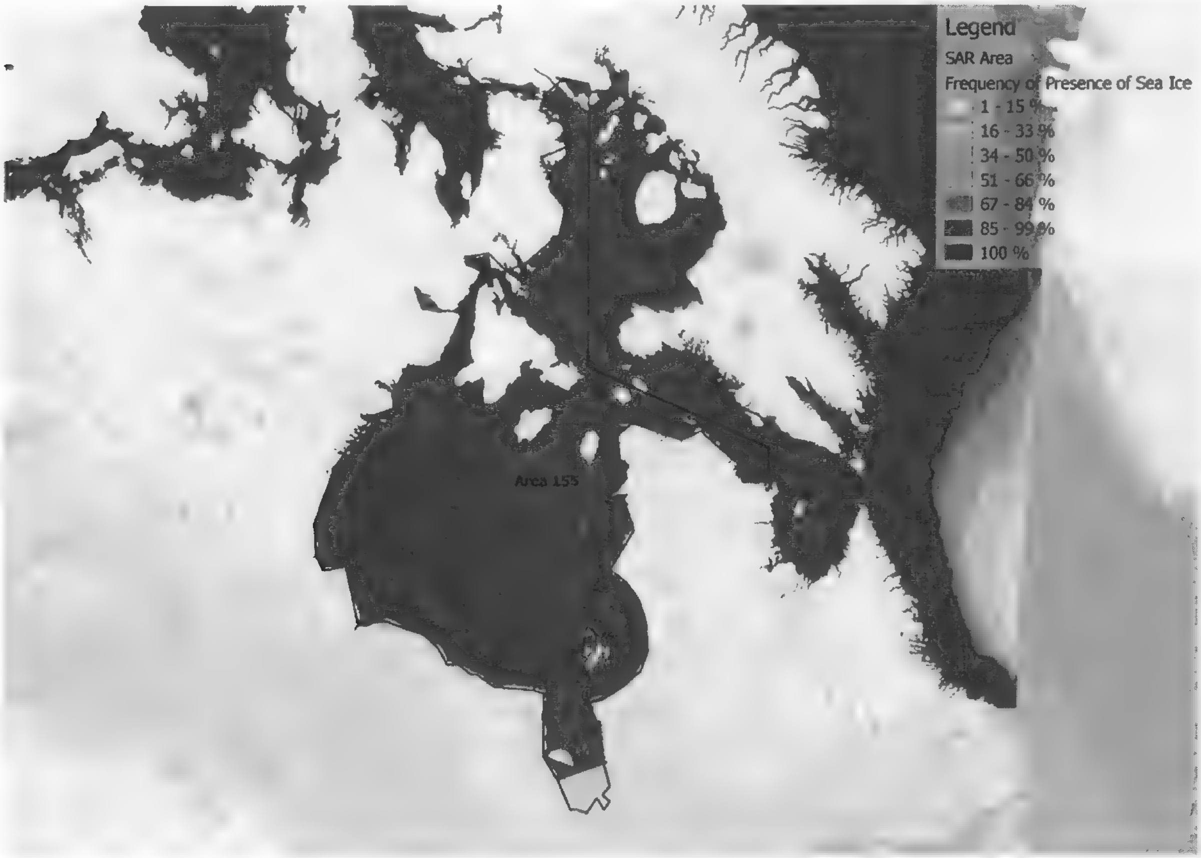

Figure 3.97 Frequency of Presence of Sea Ice for the week of April 02 within SAR Area 155 (1981 - 2010)

Median Concentration of Sea Ice

Sea Ice concentrations reach 100% for the weeks beginning January 01 through July 09 (Table 3.43 and Figure 3.98). The region is completely covered in 9 tenths or greater sea ice from the week of January 01 through April 30. The highest percentage of 10 tenths sea ice occurs the week of April 02. Figure 3.99 depicts the median concentration of sea ice for the week of April 02.

Table 3.43 Median Concentration of Sea Ice within SAR Area 155 (1981 - 2010)

	Ice Free	1/10 - 3/10	4/10 - 6/10	7/10 - 8/10	9/10 - 9+/10	10/10	Total Ice
Jan-01	0.00	0.00	0.00	0.00	95.01	4.99	100.00
Jan-08							
Jan-15							
Jan-22							
Jan-29	0.00	0.00	0.00	0.00	91.92	8.08	100.00
Feb-05							
Feb-12							
Feb-19							
Feb-26	0.00	0.00	0.00	0.00	89.90	10.10	100.00
Mar-05							
Mar-12							
Mar-19							
Mar-26							
Apr-02	0.00	0.00	0.00	0.00	88.75	11.25	100.00
Apr-09							
Apr-16							
Apr-23							
Apr-30	0.00	0.00	0.00	0.00	88.80	11.20	100.00
May-07							
May-14	0.00	0.02	0.04	0.13	89.34	10.46	100.00
May-21							
May-28							
Jun-04	0.00	0.09	1.50	2.47	90.68	5.27	100.00
Jun-11	0.00	0.15	2.29	10.81	81.22	5.52	100.00
Jun-18	0.00	0.95	6.58	14.13	74.10	4.23	100.00
Jun-25	0.00	3.05	10.88	16.35	66.89	2.84	100.00
Jul-02	0.00	6.61	21.69	12.71	57.22	1.77	100.00
Jul-09	0.00	6.86	26.55	17.97	47.40	1.23	100.00
Jul-16	0.89	11.23	31.37	41.02	14.71	0.79	99.11
Jul-23	2.15	32.66	38.78	18.17	8.03	0.21	97.85
Jul-30	16.36	29.59	29.24	18.25	6.47	0.09	83.64
Aug-06	38.30	22.66	23.28	12.24	3.47	0.06	61.70
Aug-13	52.69	19.42	17.54	8.06	2.21	0.07	47.31
Aug-20	73.76	9.82	10.70	5.08	0.64	0.00	26.24
Aug-27	80.26	7.58	9.79	2.10	0.27	0.00	19.74
Sep-03	87.65	4.78	7.08	0.29	0.20	0.00	12.35

Sep-10	89.54	3.67	5.75	0.82	0.21	0.00	10.46
Sep-17	88.86	5.13	3.84	0.95	1.22	0.00	11.14
Sep-24	89.15	5.02	3.37	1.27	1.19	0.00	10.85
Oct-01	89.08	2.67	4.30	3.60	0.36	0.00	10.92
Oct-08	87.63	3.10	4.36	3.28	1.64	0.00	12.37
Oct-15	86.90	0.98	2.81	2.11	7.18	0.03	13.10
Oct-22	80.15	2.05	4.96	2.68	10.14	0.01	19.85
Oct-29	75.70	0.04	8.43	2.76	12.95	0.11	24.30
Nov-05	47.43	0.00	10.71	2.76	38.89	0.21	52.57
Nov-12	19.16	0.63	4.21	3.82	71.77	0.40	80.84
Nov-19	6.21	0.01	4.93	4.33	83.75	0.76	93.79
Nov-26	0.00	0.00	4.06	1.10	93.93	0.92	100.00
Dec-04	0.00	0.00	0.70	4.88	93.17	1.25	100.00

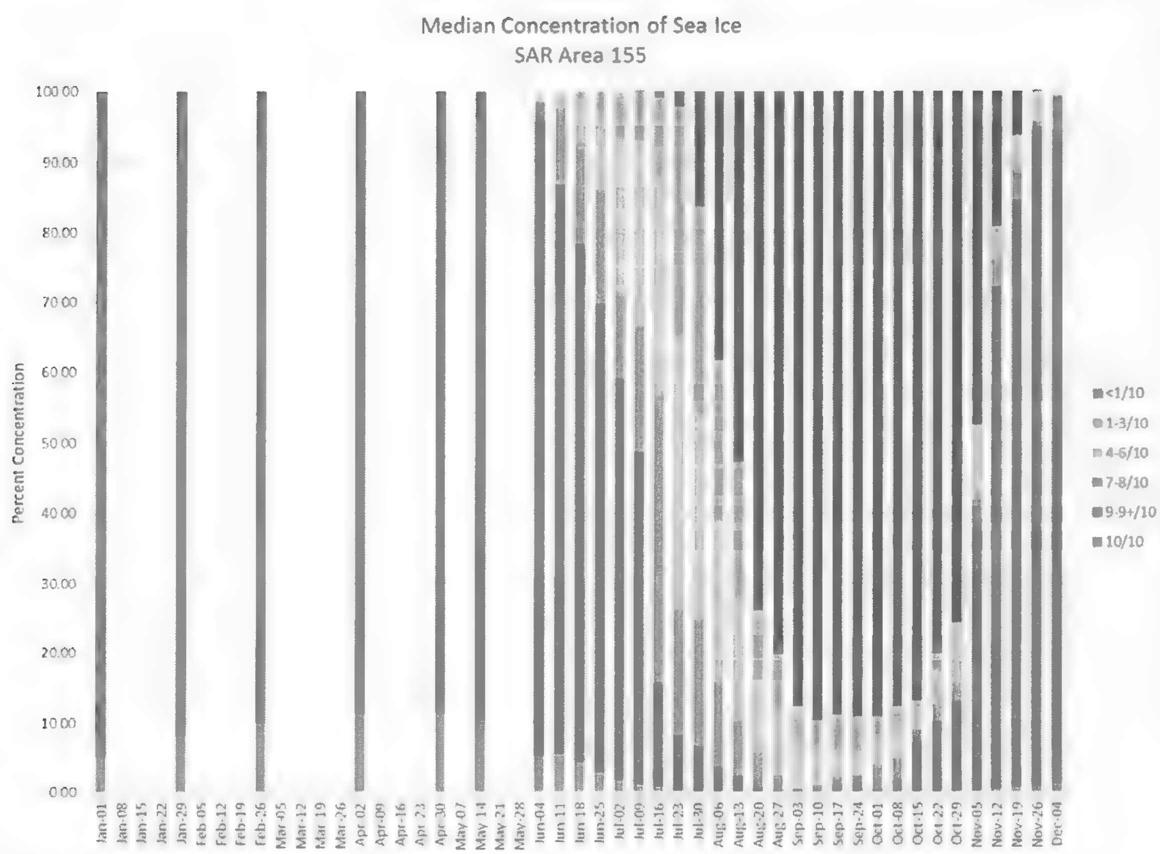

Figure 3.98 Plot of Median Concentration of Sea Ice within SAR Area 155 (1981 - 2010)

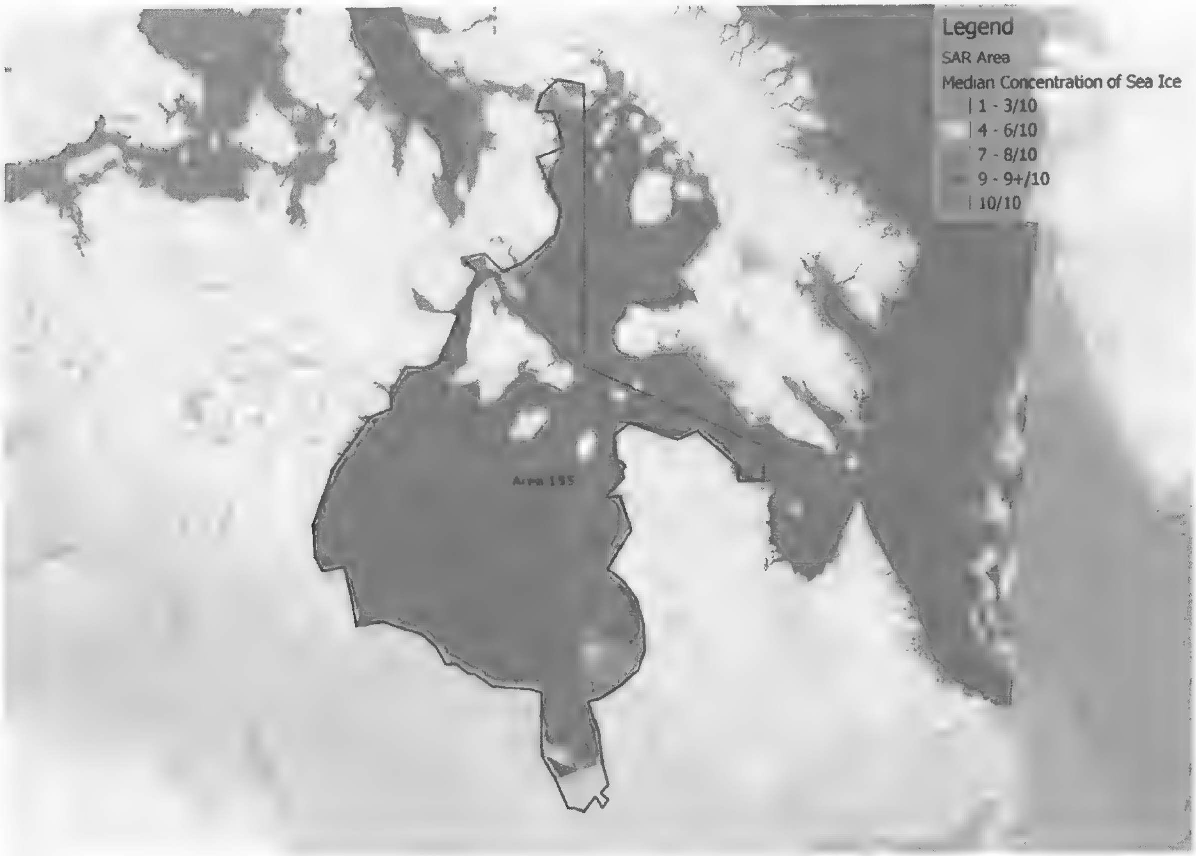

Figure 3.99 Median Concentration of Sea Ice for the week of April 02 within SAR Area 155 (1981 - 2010)

Predominant Ice Type

The presence of thick sea ice occurs within SAR Area 155 throughout the year. The weeks of January 29 and February 26 has the highest concentration of thick sea ice with 100.0% of the region covered in ice at least 15 cm thick and a concentration of 7 tenths or greater.

A chart depicting the predominant ice type when ice is present for the week of February 26 is provided below in Figure 3.100.

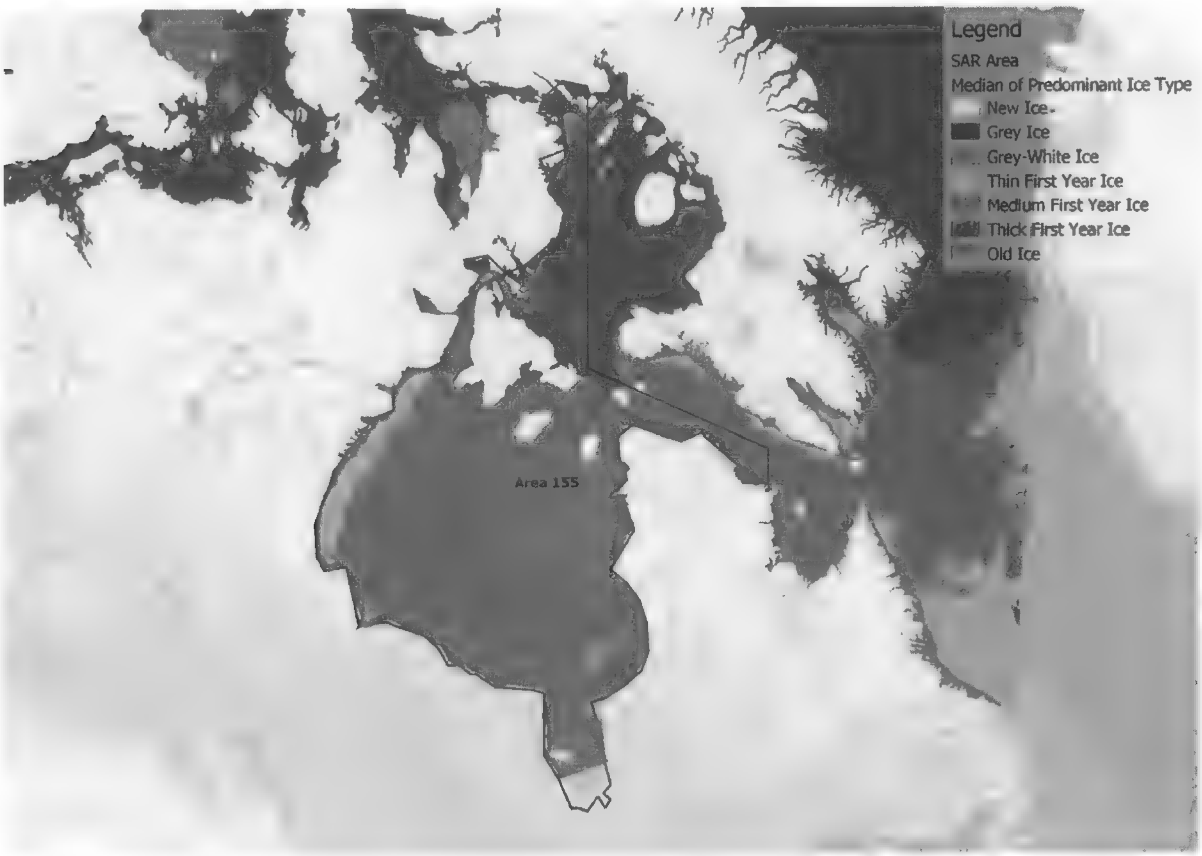

Figure 3.100 Median of Predominant Ice Type when Ice is Present (February 26)

3.2.5 *Summary Climate Statistics*

Table 3.44 Area 155 Summary Climate Statistics

Parameter	Description	Winter	Spring	Summer	Autumn
Wind Direction	Prevailing Wind Direction	NW	NNW	NNW	NW
Wind Speed	Mean Seasonal (knots)	11.4	11.3	9.9	12.1
	Mean Seasonal Maximum (kts)	38.2	37.4	32.7	40.4
Significant Wave Height	Percentage Frequency > 2.0 m	36.1	13.7	5.1	15.5
Air Temperature	Mean Temperature (°C)	-22.3	-10.5	8.9	-2.0
Sea Surface Temperature	Mean Seasonal Maximum Temperature (°C)	-0.8	NA	11.3	9.6
	Mean Seasonal Minimum Temperature (°C)	-1.0	NA	0.0	-0.6
Seasonal Sea Ice Coverage	Mean Days per Season of Ice with concentration > 7/10 and thickness > 15cm	90	92	92	91
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	85 0	100	50.4	4.5
Seasonal Sea Ice Type	New Ice	Y			Y
	Grey Ice	Y		Y	Y
	Grey-White Ice	Y			Y
	Thin First Year Ice	Y	Y	Y	Y
	Medium First Year Ice	Y	Y	Y	Y
	Thick First Year Ice	Y	Y	Y	Y
	Old Ice			Y	Y

		D	J	F	M	A	M	J	J	A	S	O	N
Monthly Sea Ice Coverage	Mean Days per Month of Ice with concentration > 7/10 and thickness > 15cm	31	31	28	31	30	31	30	31	31	30	31	30
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	41.5	99.4	100	NA	100	99.9	93.6	49.2	8.6	1.5	2.4	10.2
Monthly Sea Ice Type	New Ice	Y			NA							Y	Y
	Grey Ice	Y	Y		NA				Y			Y	Y
	Grey-White Ice	Y	Y		NA							Y	Y
	Thin First Year Ice	Y	Y	Y	NA	Y	Y						Y
	Medium First Year Ice		Y	Y	NA	Y	Y	Y	Y		Y		
	Thick First Year Ice			Y	NA	Y	Y	Y	Y	Y	Y		
	Old Ice				NA				Y	Y	Y	Y	

3.3 SAR Area 259

3.3.1 Wind Speed and Direction

Wind speed statistics from the Beaufort, ISD and ICOADS data sets for SAR Area 259 are presented in Table 3.45 through Table 3.47. Wind speeds from all ISD locations within Area 259 were combined to produced the statistics in Table 3.46. Annual wind speed vectors are provided in Figure 3.101. The highest measured absolute maximum wind speed of 43.0 knots was recorded in the ICOADS data set during the autumn season.

Wind roses of the seasonal wind speed and direction, the associated histogram of the wind speed frequency and the wind speed percentage exceedance plots for the Beaufort Grid Point 001329 located at 71.25°N; 135.75°W are presented in Figure 3.102 through Figure 3.113.

Due to local topography, winds within the Beaufort Sea tend to have a more zonal (west- to east) orientation for most of the year. During the winter months, winds are generally from the either the east or west, with the predominant wind speed being 10 - 20 knots. Winds from the east-southeast to east-northeast account for 27.6% of all winter winds while winds from the west-southwest to west-northwest account for another 27.6% of all winter winds. As spring approaches, the frequency of west to west-northwest winds decreases while the easterly wind frequency increases. Northeasterly winds from 0 - 10 knots become the most frequent wind during the summer months. By autumn, winds become more easterly once again with the 10-20 knot easterly wind being the most predominate.

Gale force winds are more frequent during the winter months. Wind speeds greater than 30 knots only occur 0.2% of the time annually.

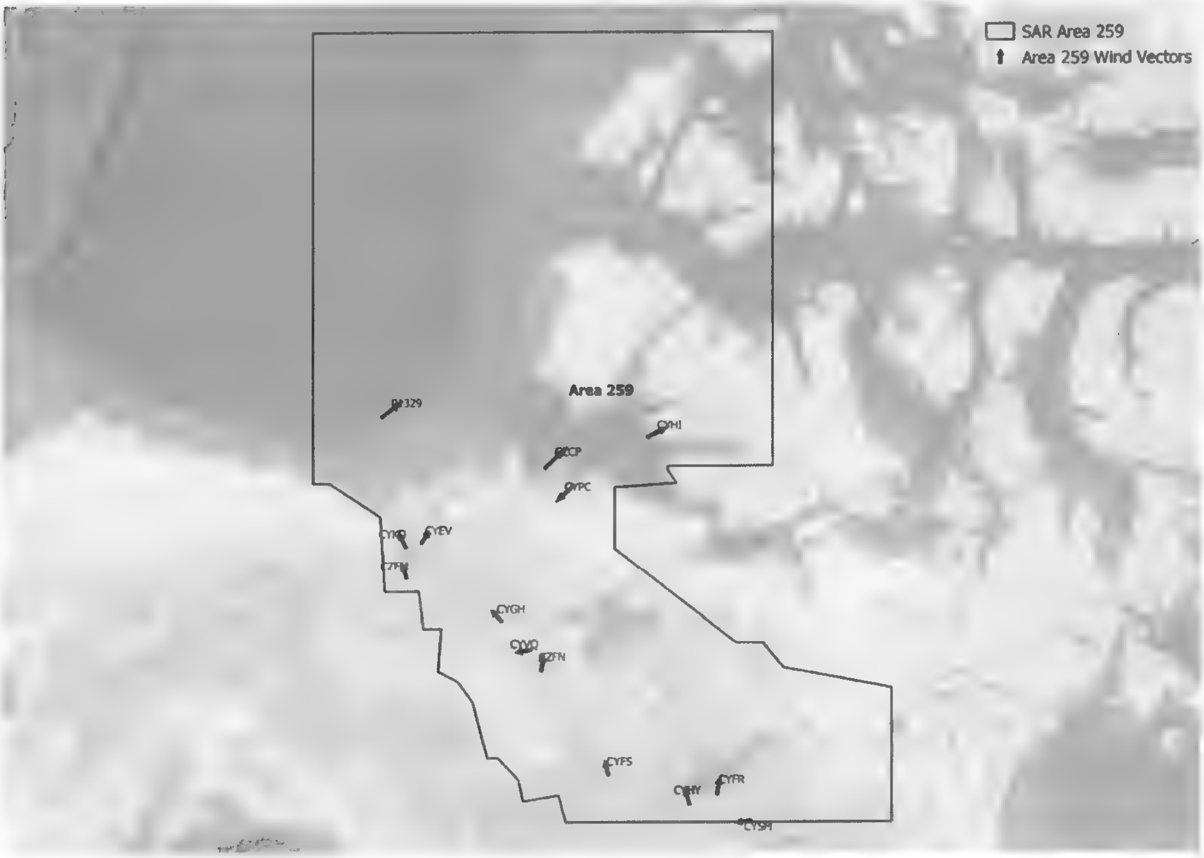

Figure 3.101 Annual Wind Vectors for SAR Area 259

Table 3.45 SAR Area 259 Seasonal Wind Speed Statistics from Beaufort Grid Point 001329 (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	11.8	5.4	30.5	47.1
Spring	11.2	4.9	26.8	35.7
Summer	10.2	4.7	25.0	32.0
Autumn	13.3	5.9	31.3	41.8

Table 3.46 SAR Area 259 Seasonal Wind Speed Statistics from the ISD data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	7.4	5.3	30.9	31.1
Spring	7.7	4.8	29.0	29.2
Summer	7.1	4.1	25.1	25.3
Autumn	7.7	5.2	30.9	31.1

Table 3.47 SAR Area 259 Seasonal Wind Speed Statistics from the ICOADS data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	11.7	6.1	33.6	39.1
Autumn	13.4	6.8	36.6	43.0

Table 3.48 SAR Area 259 Winter Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 001329)

Source: Beaufort — Total Samples: 21652

Wind Speed (knots)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	1.56	3.39	4.27	3.90	3.55	3.05	2.84	2.29	1.73	1.99	2.52	3.22	3.54	3.29	2.90	2.61	48.12
10 - 20	0.62	1.16	3.30	5.11	6.05	3.72	2.26	0.96	0.60	0.85	1.55	4.36	5.83	4.91	2.52	1.57	45.97
20 - 30	0.02	0.00	0.14	0.37	1.11	0.73	0.39	0.06	0.02	0.03	0.05	0.44	1.00	0.84	0.34	0.12	5.67
30 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.12	0.06	0.01	0.24
40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Direction (true / from)

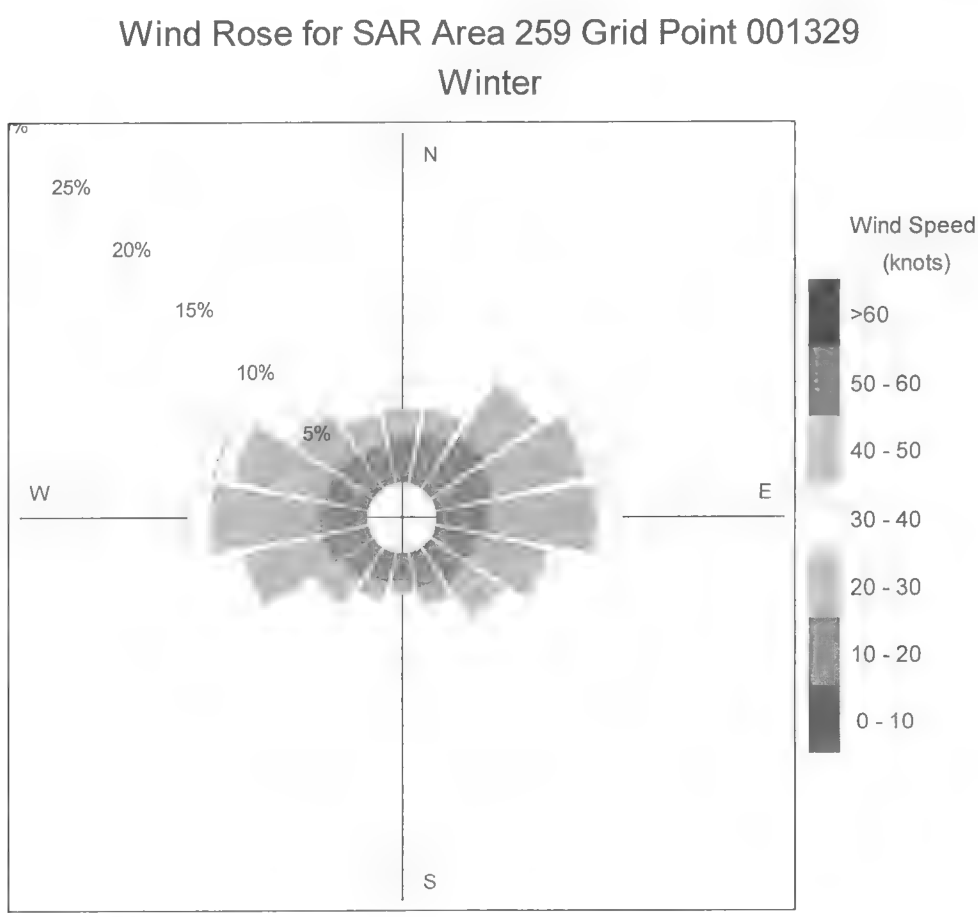

Figure 3.102 SAR Area 259 Winter Wind Rose (Grid Point 001329)

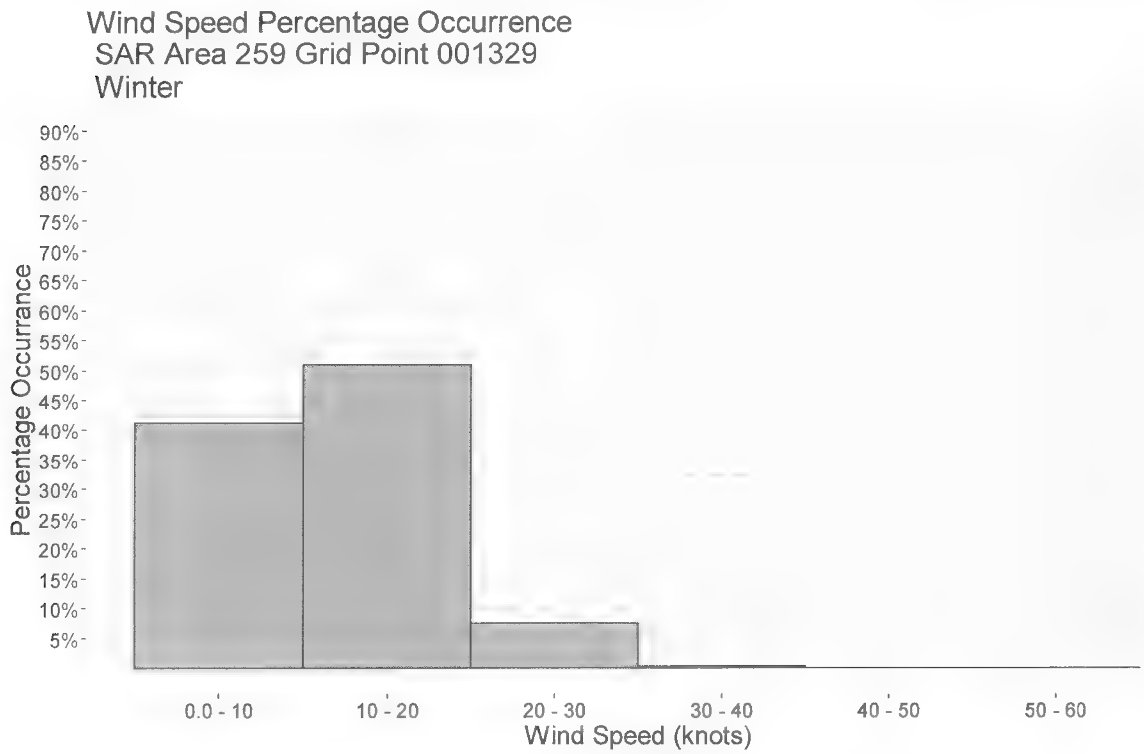

Figure 3.103 SAR Area 259 Winter Wind Speed Percentage Occurrence (Grid Point 001329)

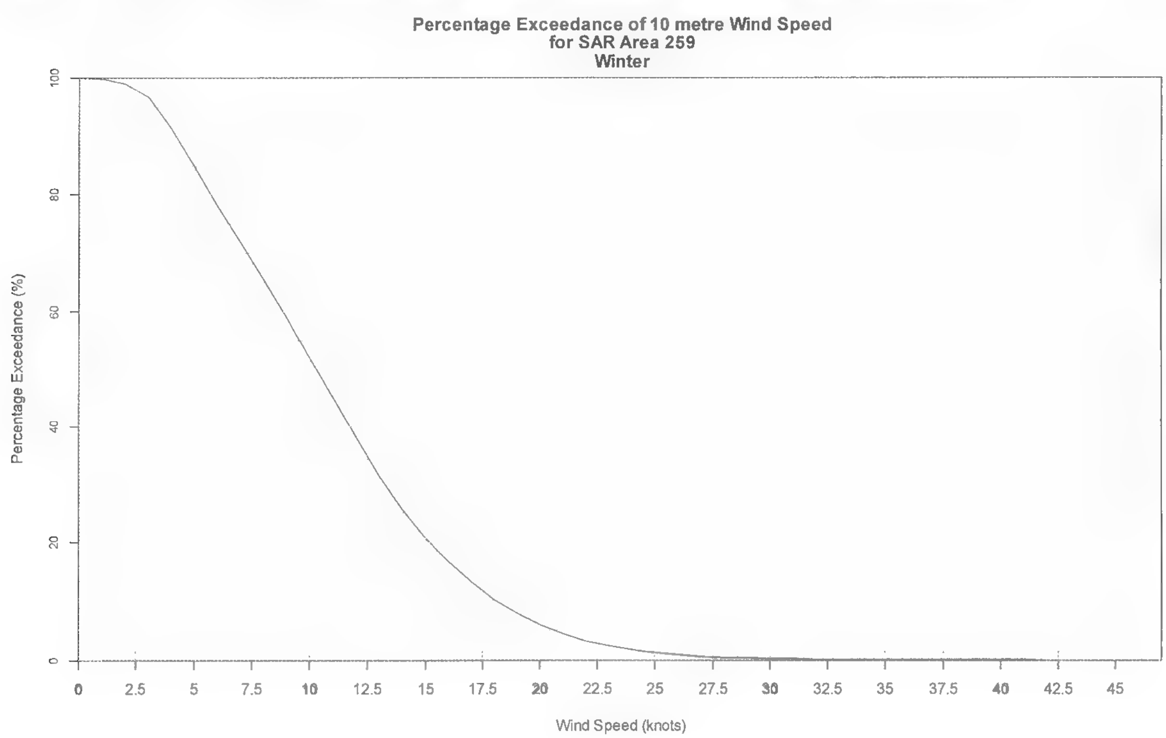

Figure 3.104 SAR Area 259 Winter Wind Speed Percentage Exceedance (Grid Point 001329)

Table 3.49 SAR Area 259 Spring Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 001329)

Source: Beaufort

Total Samples: 22072

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	2.12	4.11	5.35	5.04	4.48	4.18	3.49	2.17	1.61	1.73	2.07	2.36	2.51	2.86	2.91	3.15	52.02
	10 - 20	0.59	1.47	4.80	6.11	6.79	4.78	2.16	0.69	0.43	0.52	0.96	2.38	3.77	4.01	2.63	1.58	44.33
	20 - 30	0.01	0.05	0.17	0.46	0.75	0.71	0.18	0.06	0.03	0.02	0.02	0.07	0.19	0.49	0.30	0.10	3.65
	30 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

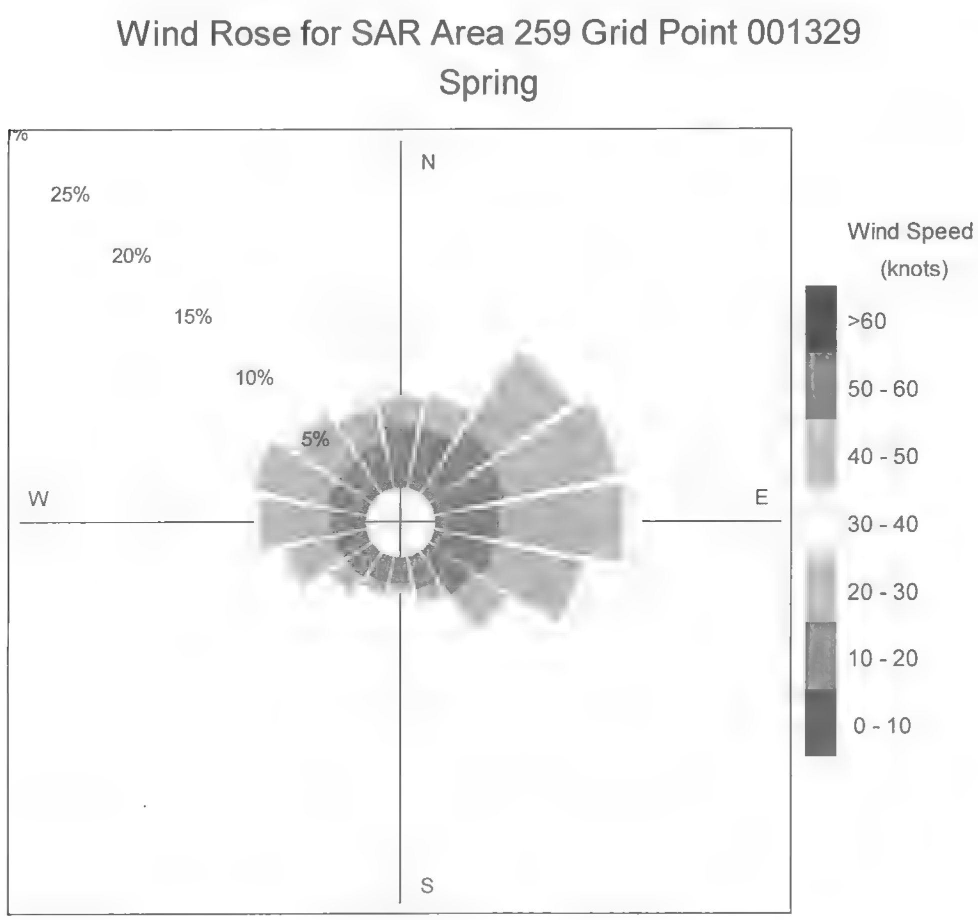

Figure 3.105 SAR Area 259 Spring Wind Rose Diagram (Grid Point 001329)

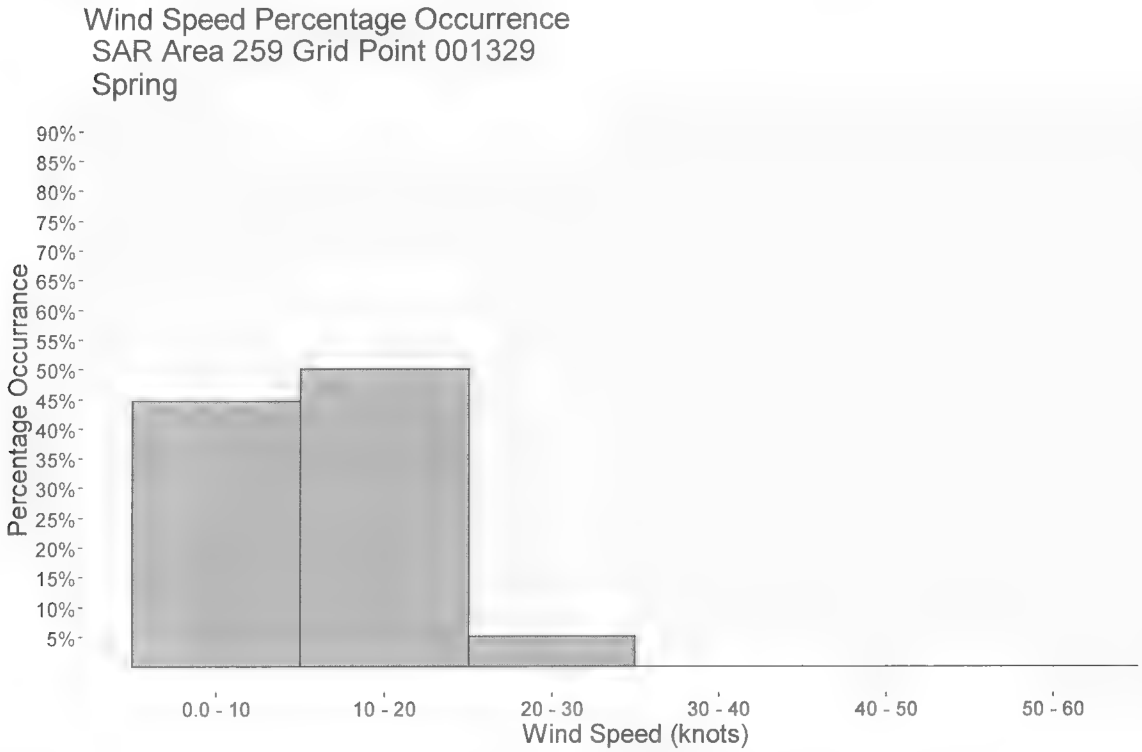

Figure 3.106 SAR Area 259 Spring Wind Speed Percentage Occurrence (Grid Point 001329)

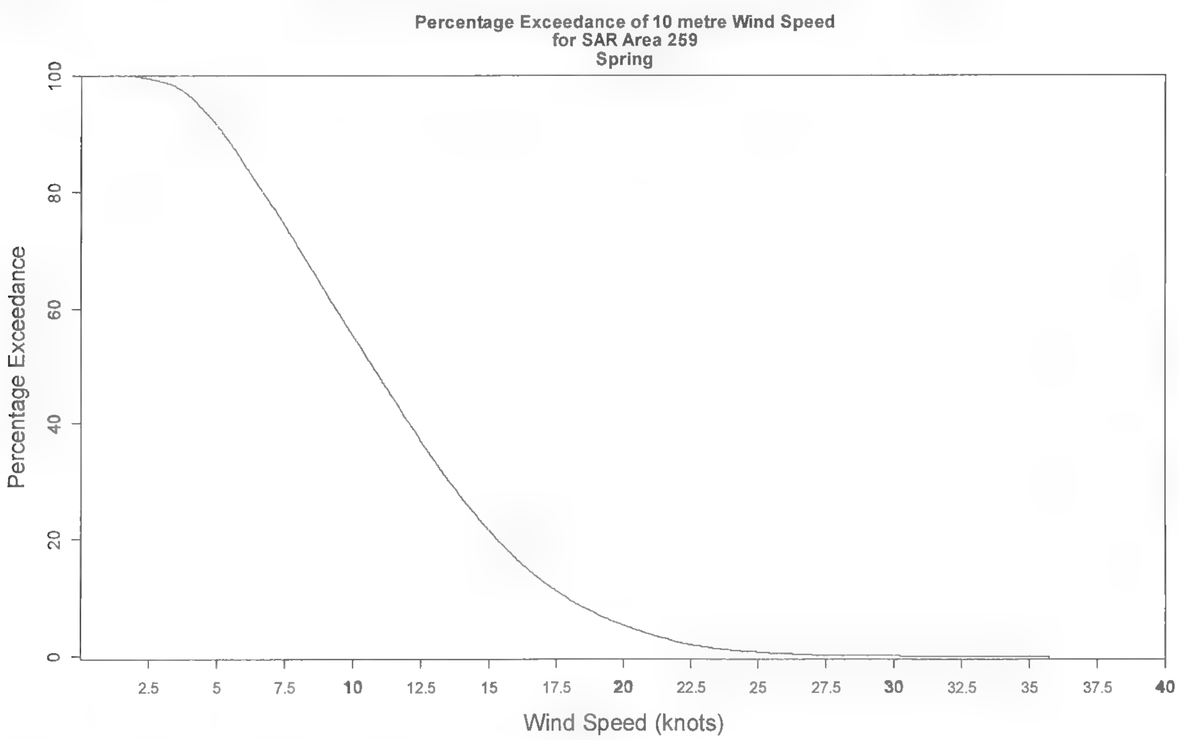

Figure 3.107 SAR Area 259 Spring Wind Speed Percentage Exceedance (Grid Point 001329)

Table 3.50 SAR Area 259 Summer Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 001329)

Source: Beaufort Total Samples: 22076

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	1.85	4.11	6.66	6.37	6.23	5.68	4.49	2.65	2.12	1.78	2.10	2.75	3.13	3.32	2.94	3.50	61.02
	10 - 20	0.88	1.87	3.63	5.12	5.75	3.85	1.49	0.36	0.24	0.43	0.60	1.74	2.98	3.46	2.08	1.65	36.81
	20 - 30	0.01	0.01	0.14	0.33	0.32	0.29	0.02	0.00	0.00	0.02	0.01	0.07	0.32	0.34	0.14	0.12	2.17
	30 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

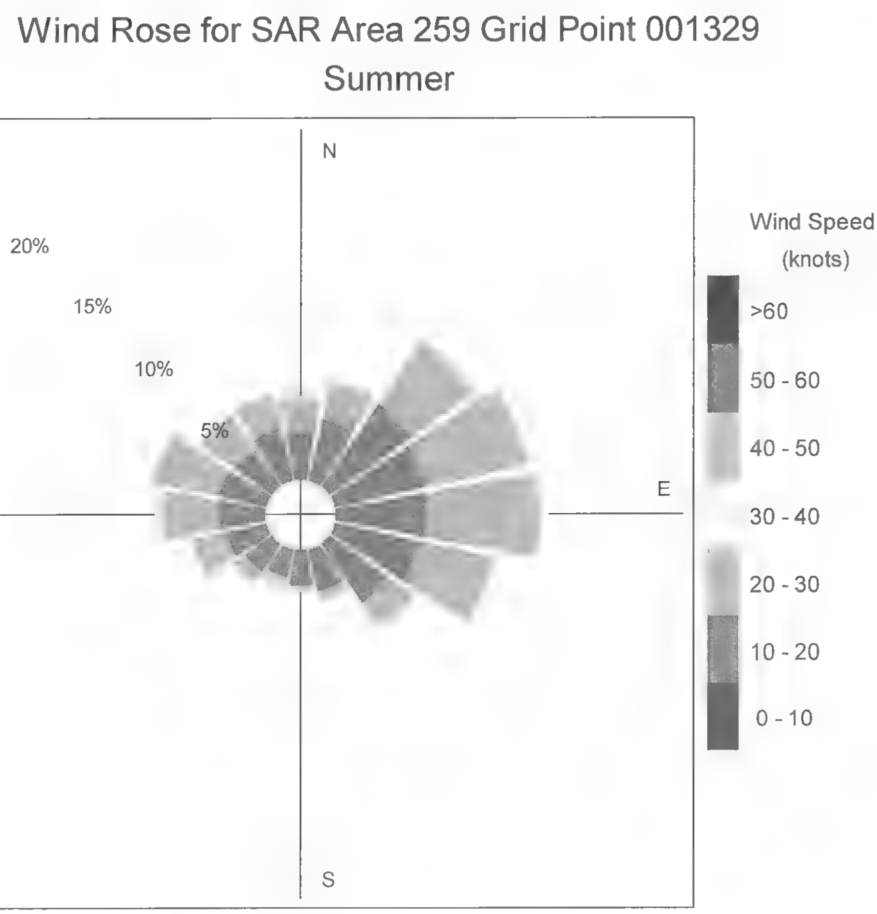

Figure 3.108 SAR Area 259 Summer Wind Rose Diagram (Grid Point 001329)

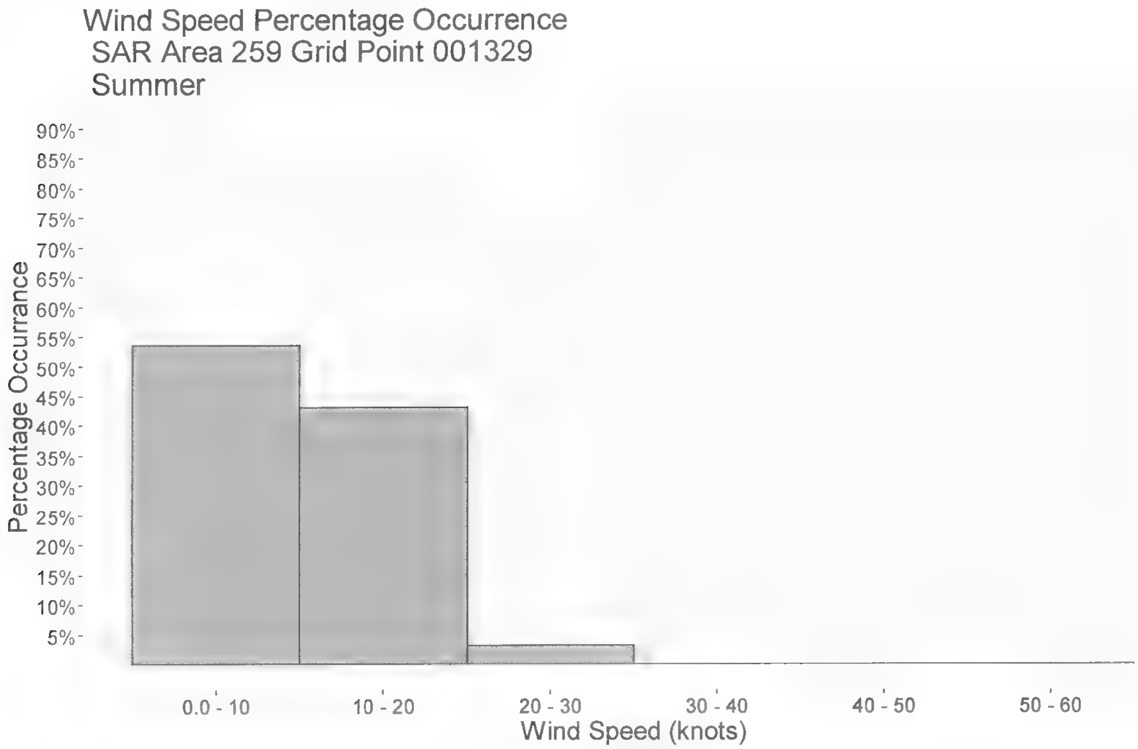

Figure 3.109 SAR Area 259 Summer Wind Speed Percentage Occurrence (Grid Point 001329)

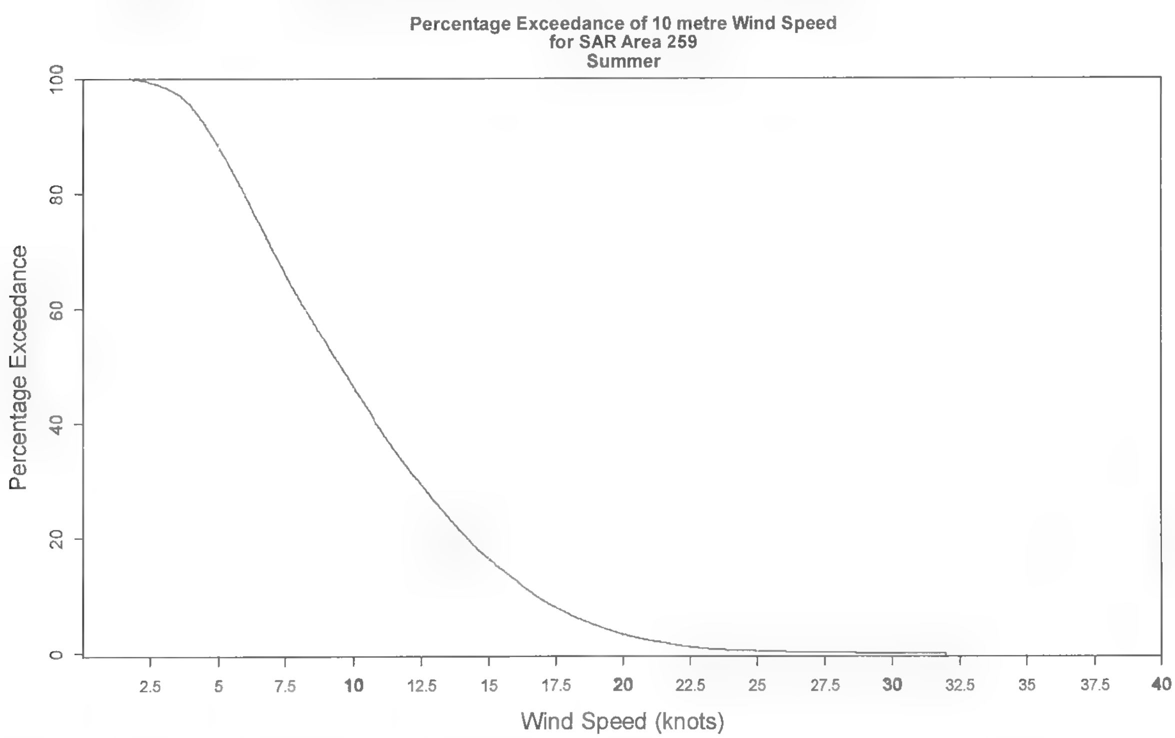

Figure 3.110 SAR Area 259 Summer Wind Speed Percentage Exceedance (Grid Point 001329)

Table 3.51 SAR Area 259 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (Grid Point 001329)

Source: Beaufort

Total Samples: 21837

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	1.38	2.48	3.25	2.94	3.08	2.64	2.34	2.23	1.79	1.74	1.91	2.36	2.42	2.30	2.39	2.37	38.69
	10 - 20	1.29	2.43	5.56	5.65	6.99	5.28	2.48	1.31	0.84	0.85	1.53	3.38	3.68	3.74	2.44	2.25	50.48
	20 - 30	0.13	0.23	0.64	1.91	2.34	1.70	0.67	0.12	0.03	0.03	0.10	0.46	0.54	0.65	0.33	0.35	10.36
	30 - 40	0.00	0.01	0.03	0.10	0.14	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.47
	40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

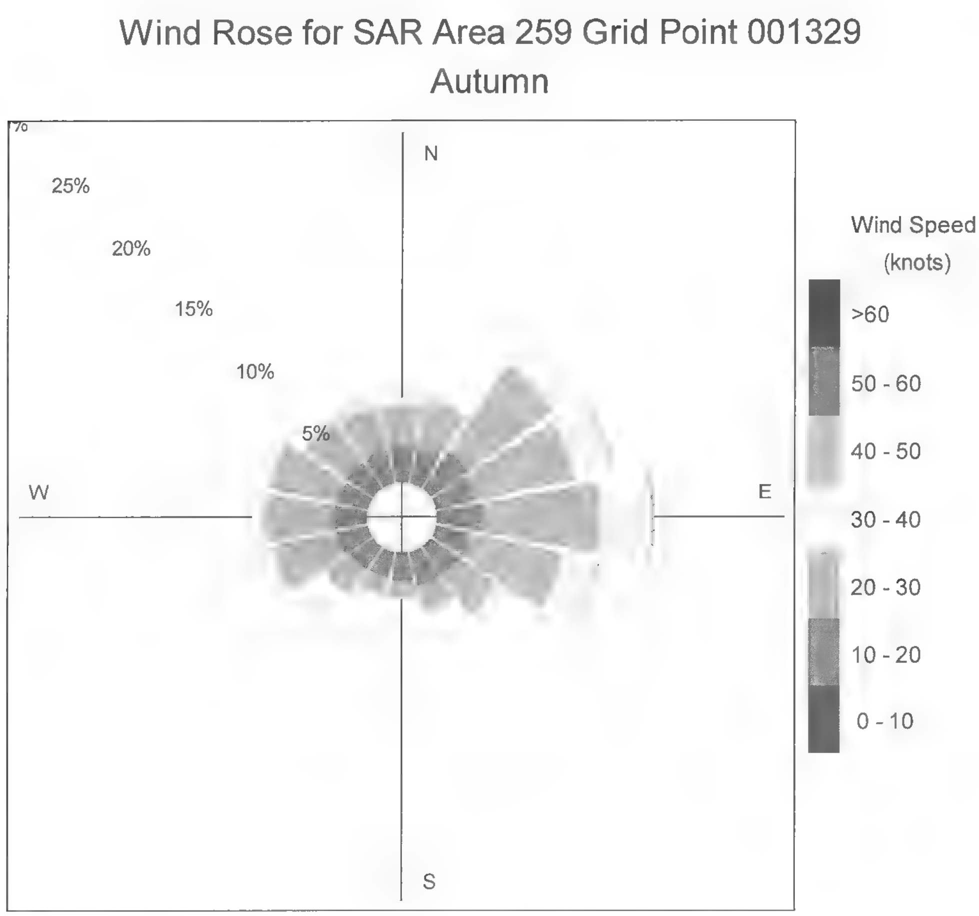

Figure 3.111 SAR Area 259 Autumn Wind Rose Diagram (Grid Point 001329)

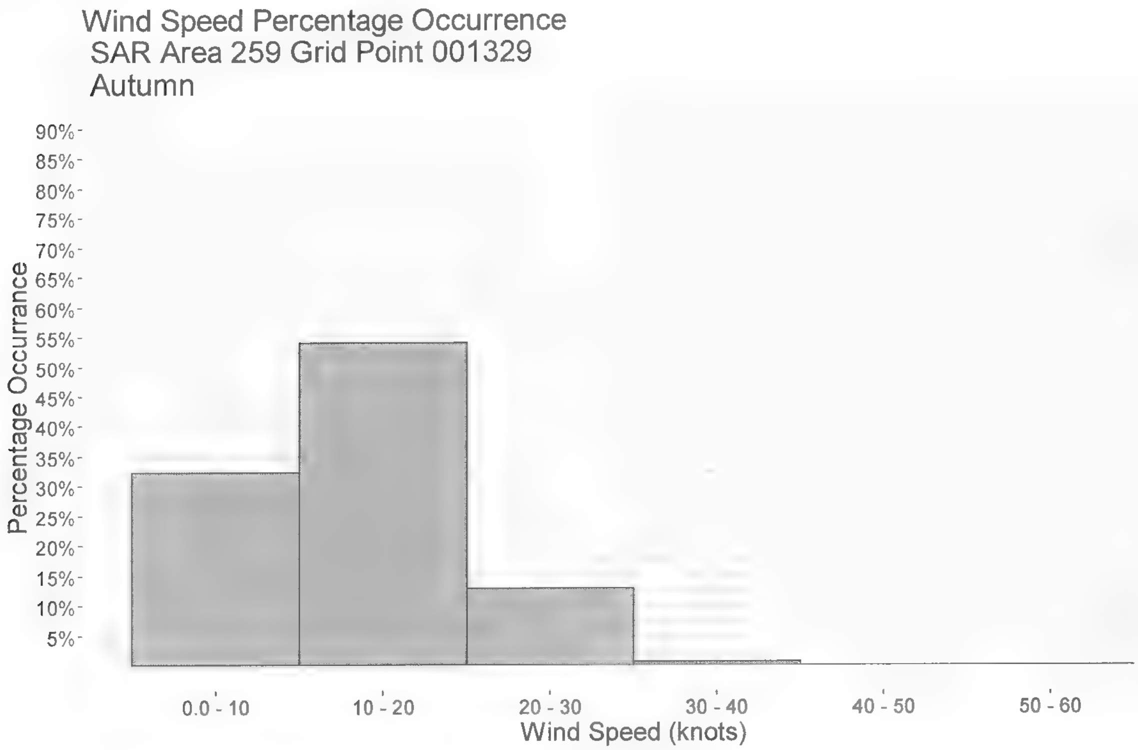

Figure 3.112 SAR Area 259 Autumn Wind Speed Percentage Occurrence (Grid Point 001329)

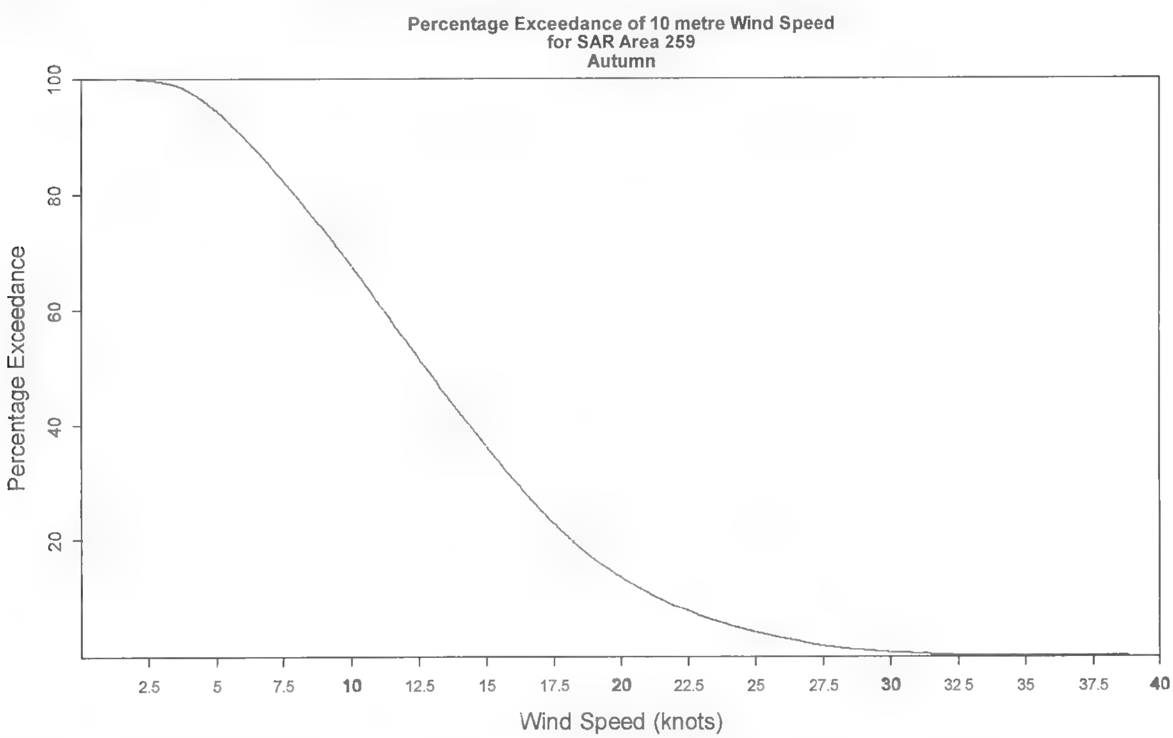

Figure 3.113 SAR Area 259 Autumn Wind Speed Percentage Exceedance (Grid Point 001329)

3.3.2 Wave Height

Significant Wave Height

While significant wave heights are typically low over the Beaufort Sea, strong west to northwest winds can bring large waves to the region. Seasonal mean, standard deviation, mean maximum and absolute maximum significant wave height statistics are provided in Table 3.52 and Table 3.53 for SAR Area 259. Due to the presence of sea ice, wave data from Beaufort grid point 001329 is unavailable for the winter and spring seasons. The highest autumn wave height in both the Beaufort hindcast data set and within the ICOADS data set are 7.0 metres or greater.

Tables depicting the joint percentage frequency distribution of significant wave height and direction for summer and autumn are provided in Table 3.54 and Table 3.55. The predominate wave during the summer season is a 0.0 – 1.0 metre easterly wave. In autumn, the predominate wave remains easterly, increasing to 1.0 – 2.0 metres.

Wave roses of the seasonal significant wave height and direction, the associated histogram of the significant wave height frequency and the significant wave height percentage exceedance are presented in Figure 3.114 through Figure 3.119. The wave roses are in meteorological convention and depict the direction the waves are coming from.

Table 3.52 SAR Area 259 Seasonal Significant Wave Height Statistics from Beaufort Grid Point 01329 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	0.3	0.6	2.2	4.6
Autumn	0.7	1.0	4.0	7.4

Table 3.53 SAR Area 259 Seasonal Significant Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	3.1	2.3	4.2	10.6
Spring	2.3	1.3	2.8	5.5
Summer	1.1	0.7	2.8	4.3
Autumn	1.6	1.2	3.8	7.0

Table 3.54 SAR Area 259 Summer Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 001329)

Source: Beaufort

Total Samples: 8844

	Wave Direction (true / from)																
Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	2.70	3.61	6.16	7.63	11.71	9.09	3.81	1.52	0.96	0.98	1.74	2.91	5.26	4.59	2.53	3.09	68.29
1.0 - 2.0	0.84	1.14	2.15	3.53	4.36	3.18	1.35	0.19	0.10	0.25	0.41	1.02	2.88	3.00	1.54	1.02	26.94
2.0 - 3.0	0.14	0.08	0.23	0.62	0.75	0.60	0.05	0.00	0.00	0.00	0.00	0.11	0.69	0.63	0.32	0.05	4.25
3.0 - 4.0	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.08	0.00	0.00	0.37
4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.00	0.00	0.14
5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

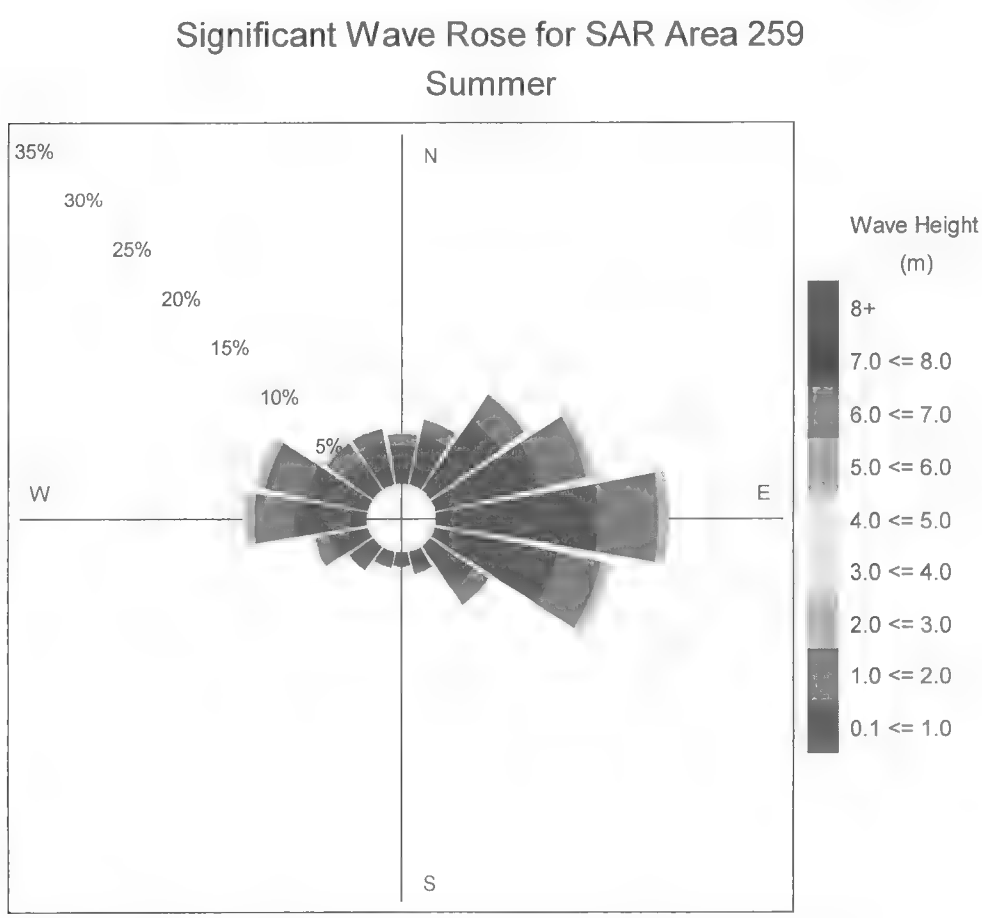

Figure 3.114 SAR Area 259 Summer Significant Wave Rose Diagram (Grid Point 001329)

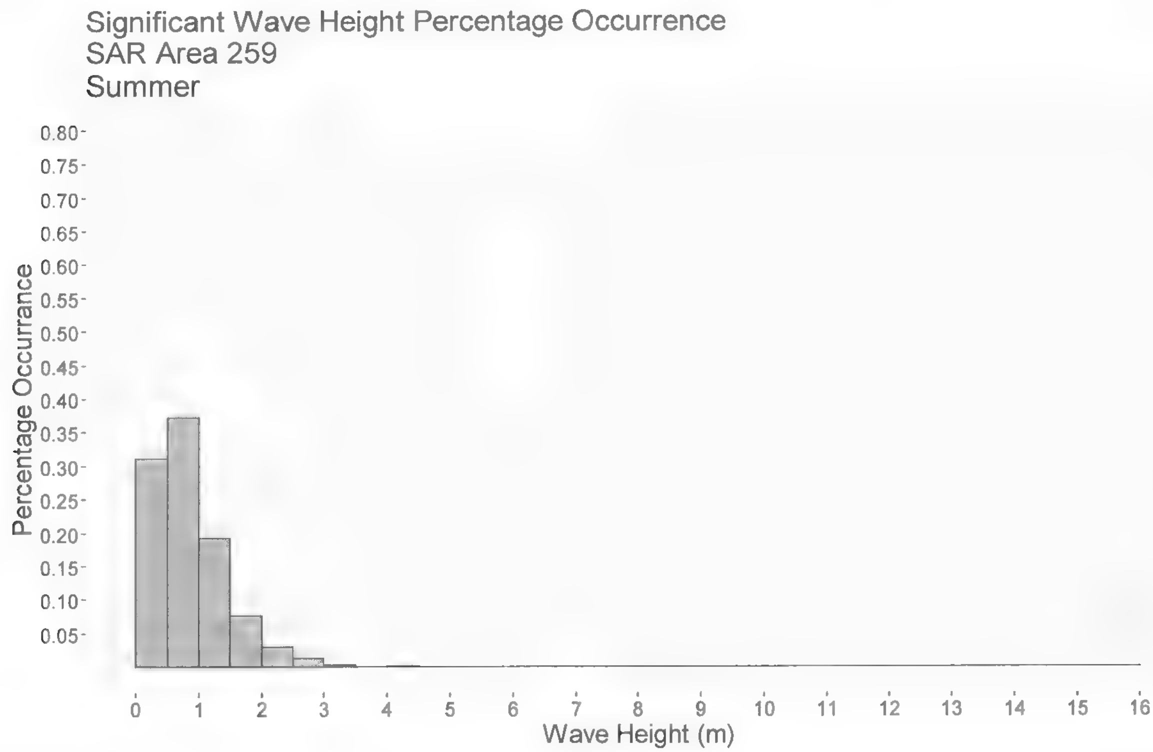

Figure 3.115 SAR Area 259 Summer Significant Wave Height Percentage Occurrence (Grid Point 001329)

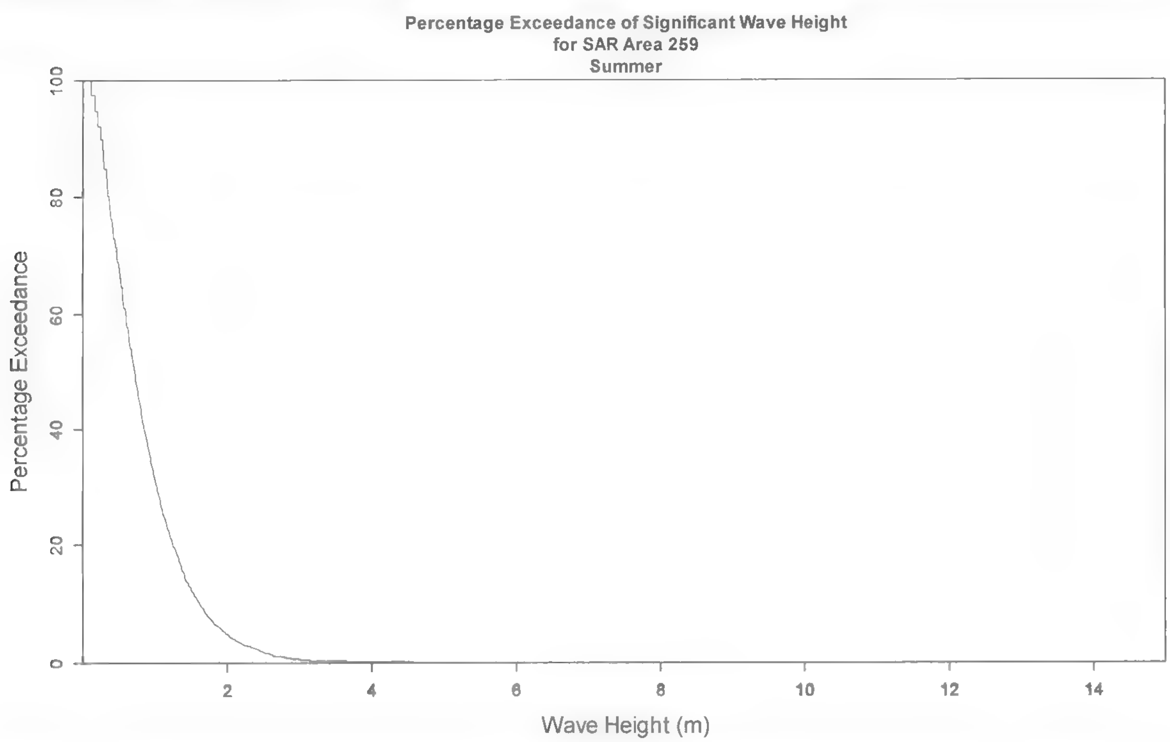

Figure 3.116 SAR Area 259 Summer Significant Wave Height Percentage Exceedance (Grid Point 001329)

Table 3.55 SAR Area 259 Autumn Joint Percentage Frequency Distribution of Wave Direction versus Significant Wave Height (Grid Point 001329)

Source: MSC50 Total Samples: 9789

Wave Height (m)	Wave Direction (true / from)																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	1.68	2.25	2.55	1.93	3.84	4.04	2.28	1.12	0.89	0.80	1.14	1.85	2.86	2.19	1.60	1.82	32.83
1.0 - 2.0	1.46	2.25	3.63	5.37	6.10	5.66	2.31	1.48	0.93	0.65	1.47	2.27	3.64	2.85	1.46	1.77	43.29
2.0 - 3.0	0.39	0.65	0.49	2.25	2.98	3.33	0.93	0.38	0.22	0.21	0.32	0.77	1.13	1.10	0.46	0.48	16.10
3.0 - 4.0	0.10	0.05	0.16	0.60	1.78	1.17	0.49	0.08	0.00	0.03	0.00	0.18	0.47	0.41	0.16	0.05	5.75
4.0 - 5.0	0.00	0.00	0.01	0.07	0.79	0.53	0.12	0.00	0.00	0.00	0.00	0.00	0.26	0.04	0.00	0.00	1.82
5.0 - 6.0	0.00	0.00	0.00	0.00	0.03	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.20
6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

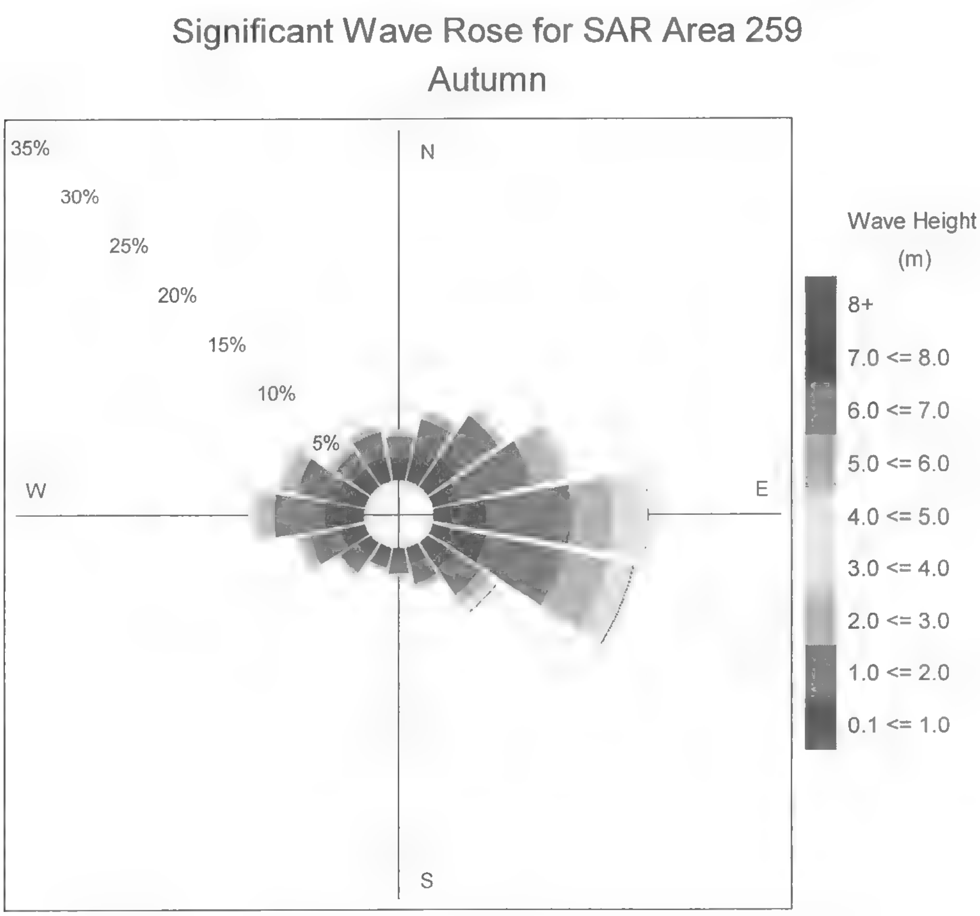

Figure 3.117 SAR Area 259 Autumn Significant Wave Rose Diagram (Grid Point 001329)

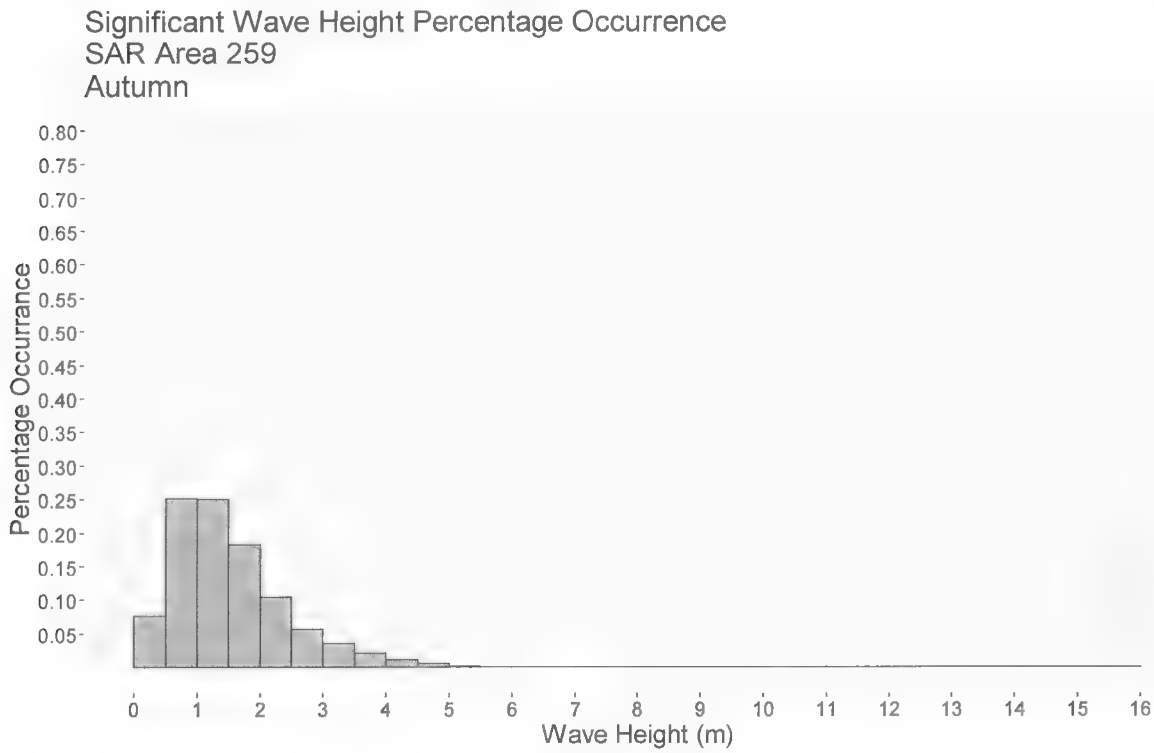

Figure 3.118 SAR Area 259 Autumn Significant Wave Height Percentage Occurrence (Grid Point 001329)

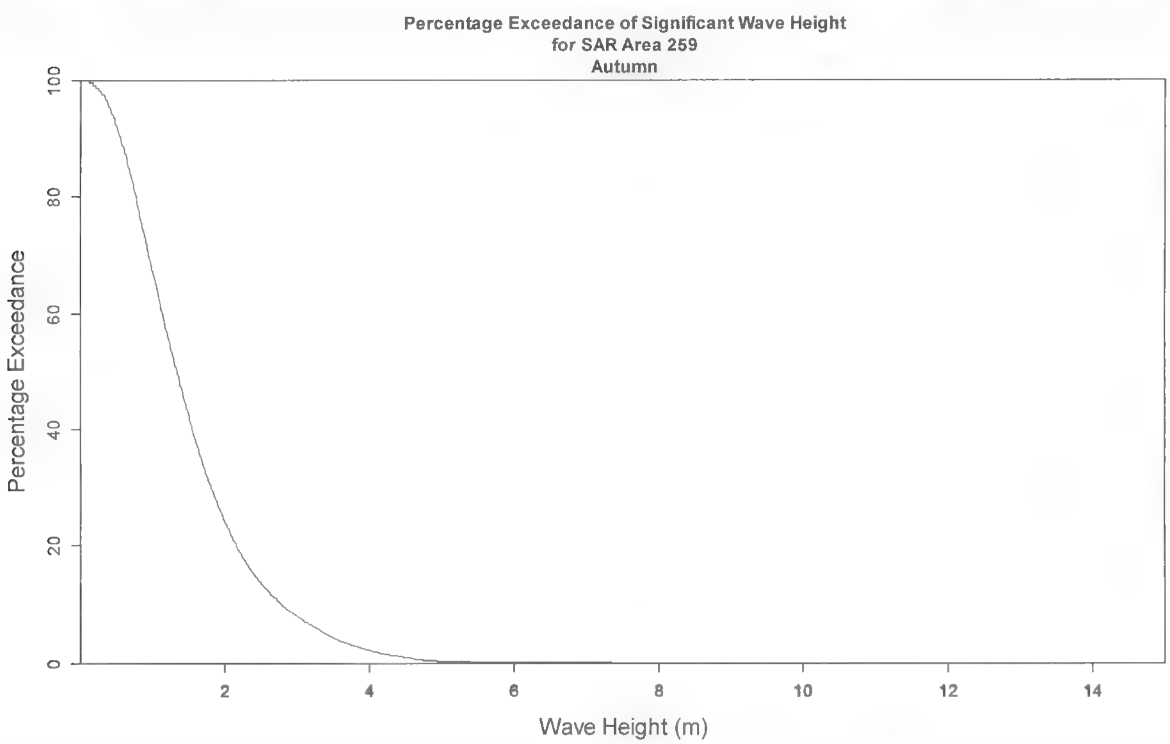

Figure 3.119 SAR Area 259 Autumn Significant Wave Height Percentage Exceedance (Grid Point 001329)

Wind Wave Height

Wave heights within Area 259 are largely governed by winds and the fetch which it blows across. Sea ice during the winter and spring seasons would reduce the fetch over the open water, thereby reducing the wave height. The seasonal mean, standard deviation, mean maximum and absolute maximum wind wave height statistics are provided in Table 3.56 and Table 3.57 for SAR Area 259.

Tables depicting the joint percentage frequency distribution of wind wave height and direction for summer and autumn are provided in Table 3.58 and Table 3.59. The predominate wind wave during the summer season is a 0.0 – 1.0 metre easterly wave. In autumn, the predominate wind wave remains easterly, increasing to 1.0 – 2.0 metres.

Wave roses of the seasonal wind wave height and direction, the associated histogram of the wind wave height frequency and the wind wave height percentage exceedance are presented in Figure 3.120 through Figure 3.125. The wave roses are in meteorological convention and depict the direction the wind waves are coming from.

Table 3.56 SAR Area 259 Seasonal Wind Wave Height Statistics from MSC50 Grid Point 001329 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	0.3	0.5	2.1	4.5
Autumn	0.6	0.9	3.8	7.3

Table 3.57 SAR Area 259 Seasonal Wind Wave Height Statistics from the ICOADS data set (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	2.0	1.5	2.5	7.0
Spring	1.6	1.1	2.0	5.5
Summer	1.1	0.6	2.4	4.0
Autumn	1.5	0.9	3.6	5.5

Table 3.58 SAR Area 259 Summer Joint Percentage Frequency Distribution of Wave Direction versus Wave Height (Grid Point 001329)

Source: Beaufort | Total Samples: 7199

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	3.36	4.68	7.56	8.33	9.78	6.79	3.64	1.58	0.86	1.18	1.79	2.86	3.96	4.07	2.88	4.01	67.34
	1.0 - 2.0	0.94	1.10	2.35	4.08	4.95	3.03	1.21	0.14	0.08	0.25	0.38	1.22	2.56	3.01	1.65	0.99	27.93
	2.0 - 3.0	0.08	0.03	0.25	0.68	0.78	0.68	0.06	0.00	0.00	0.00	0.06	0.06	0.53	0.56	0.35	0.06	4.15
	3.0 - 4.0	0.00	0.00	0.00	0.00	0.04	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.08	0.00	0.00	0.42
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.06	0.00	0.00	0.15
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

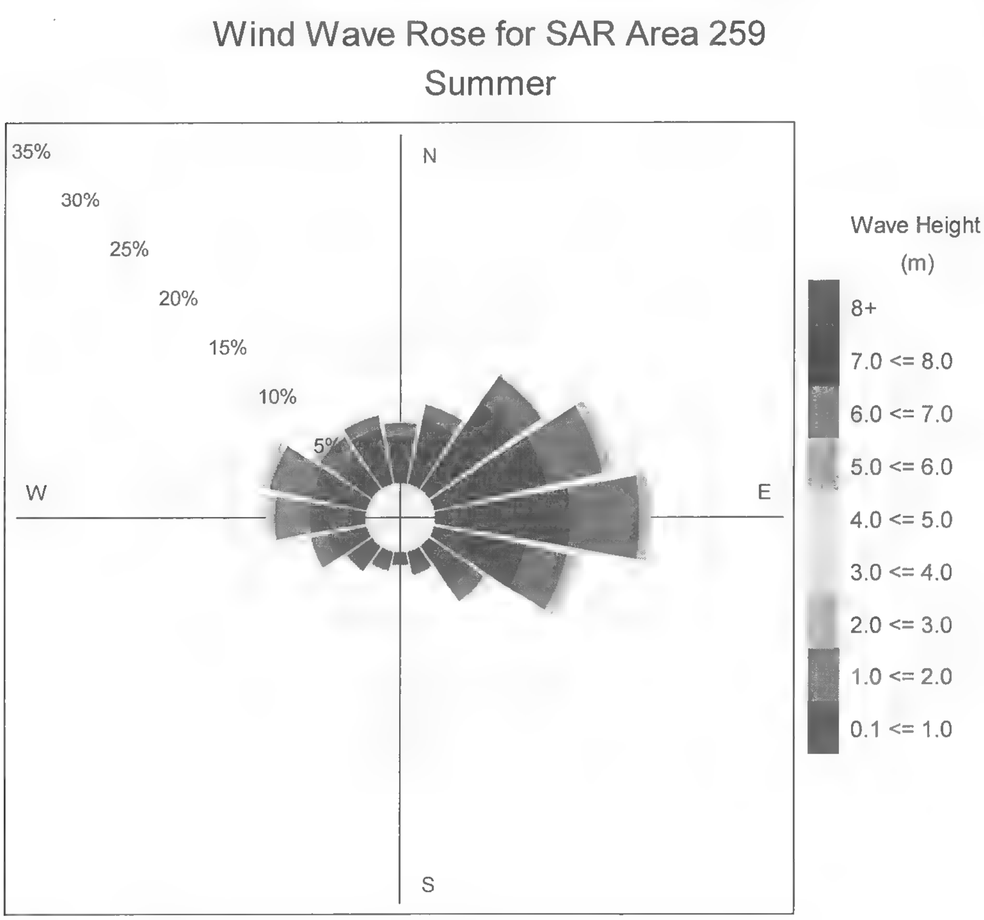

Figure 3.120 SAR Area 259 Summer Wind Wave Rose Diagram (Grid Point 001329)

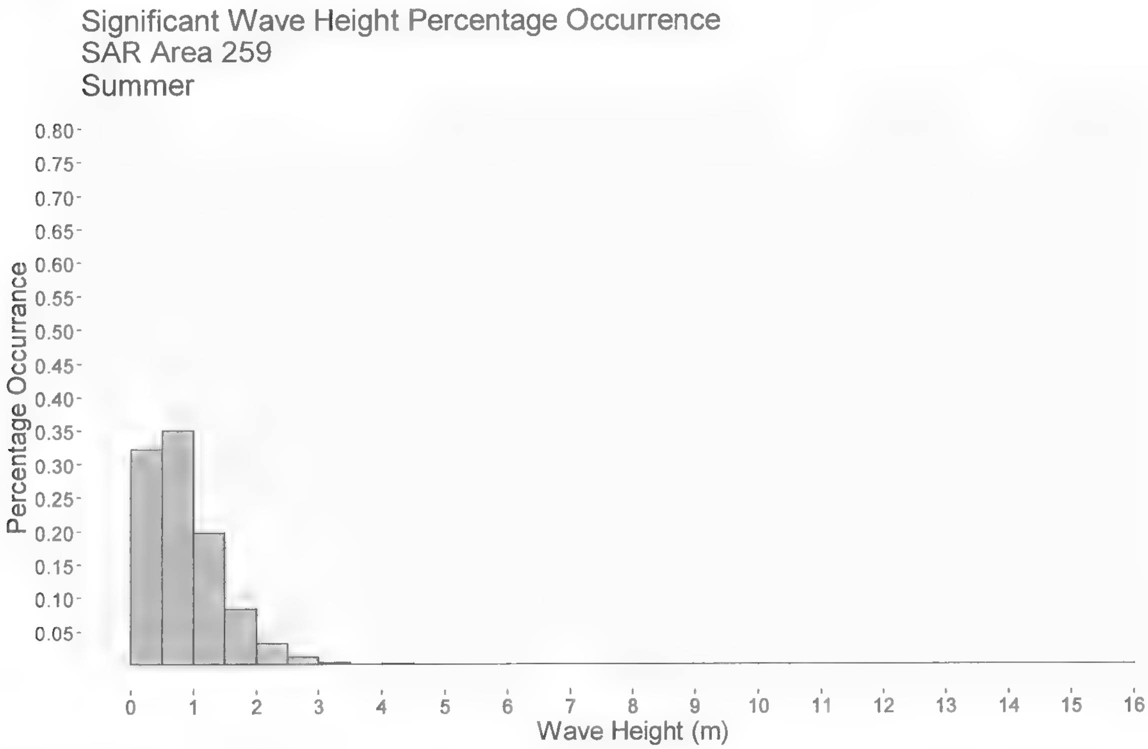

Figure 3.121 SAR Area 259 Summer Wind Wave Height Percentage Occurrence (Grid Point 001329)

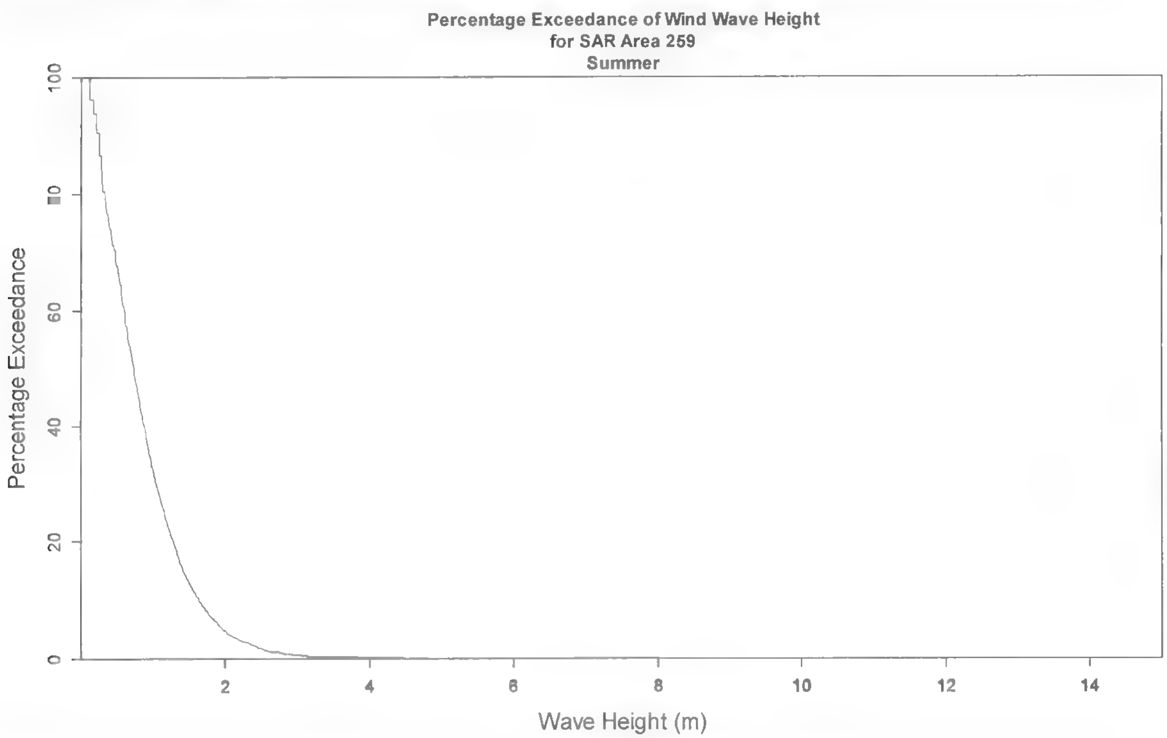

Figure 3.122 SAR Area 259 Summer Wind Wave Height Percentage Exceedance (Grid Point 001329)

Table 3.59 SAR Area 259 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (Grid Point 001329)

Source: Beaufort

Total Samples: 9143

	Wave Direction (true / from)																
Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	2.38	2.81	3.40	3.14	4.22	3.20	2.91	2.03	1.61	1.41	1.61	2.08	2.12	2.10	2.27	2.31	39.62
1.0 - 2.0	1.55	2.07	3.88	5.03	5.81	4.68	1.92	0.95	0.61	0.54	1.10	2.30	2.73	2.34	1.37	1.43	38.32
2.0 - 3.0	0.35	0.62	0.71	1.98	2.90	3.11	0.77	0.34	0.11	0.17	0.19	0.68	0.89	0.92	0.43	0.50	14.66
3.0 - 4.0	0.10	0.02	0.19	0.83	1.77	1.09	0.52	0.01	0.01	0.01	0.00	0.20	0.43	0.39	0.14	0.03	5.75
4.0 - 5.0	0.00	0.00	0.03	0.05	0.68	0.38	0.10	0.00	0.00	0.00	0.00	0.01	0.24	0.03	0.00	0.00	1.53
5.0 - 6.0	0.00	0.00	0.00	0.00	0.02	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Wave Rose for SAR Area 259
Autumn

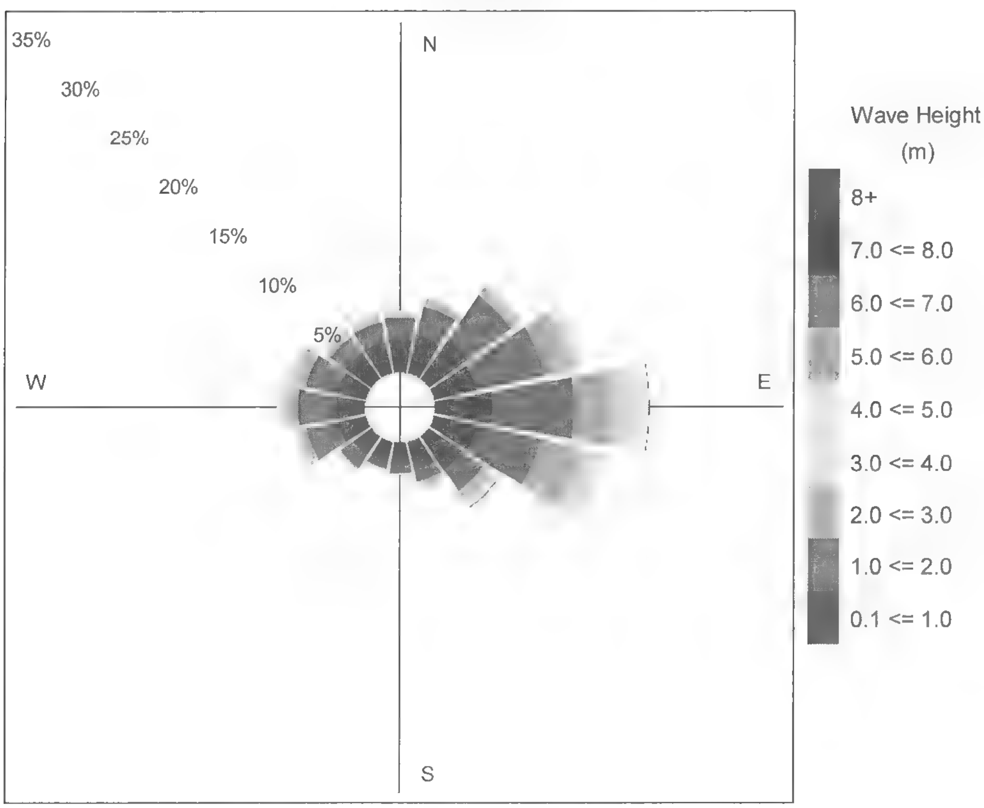

Figure 3.123 SAR Area 259 Autumn Wind Wave Rose Diagram (Grid Point 001329)

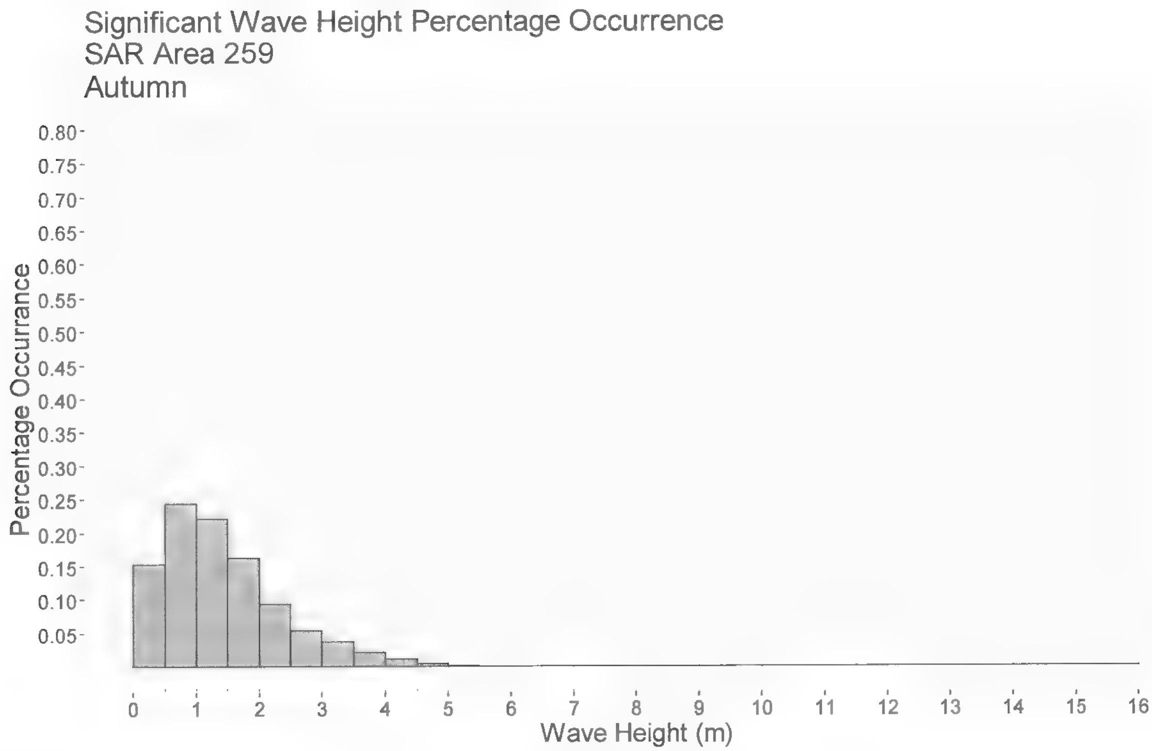

Figure 3.124 SAR Area 259 Autumn Wave Height Percentage Occurrence (Grid Point 001329)

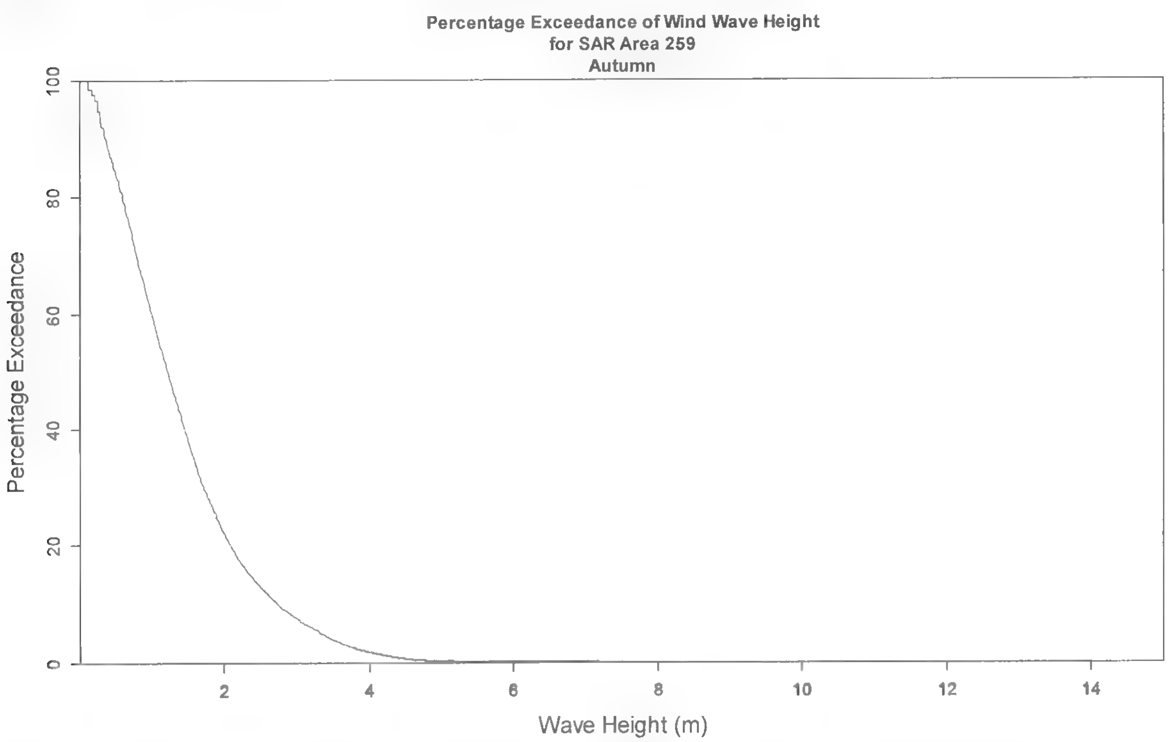

Figure 3.125 SAR Area 259 Autumn Wave Height Percentage Exceedance (Grid Point 001329)

Swell Height

Seasonal mean, standard deviation, mean maximum and absolute maximum swell height statistics are provided in Table 3.60 and Table 3.61 for SAR Area 259.

Tables depicting the joint percentage frequency distribution of significant wave height and direction for summer and autumn are provided in Table 3.62 and Table 3.63. The predominate swell during the summer and autumn seasons is a 0.0 – 1.0 metre east-southeasterly swell.

Swell wave roses of the seasonal swell height and direction, the associated histogram of the swell height frequency and the swell height percentage exceedance are presented in Figure 3.126 through Figure 3.131. The wave roses are in meteorological convention and depict the direction the swells are coming from.

Due to the presence of sea ice, swell statistics are unavailable for the winter and spring seasons.

Table 3.60 SAR Area 259 Seasonal Swell Height Statistics from MSC50 Grid Point 001329 (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	0.1	0.2	1.1	2.4
Autumn	0.2	0.4	1.8	2.9

Table 3.61 SAR Area 259 Seasonal Swell Height Statistics from the ICOADS data set (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	1.3	0.7	2.1	4.0
Autumn	1.7	1.0	2.8	6.0

Table 3.62 SAR Area 259 Summer Joint Percentage Frequency Distribution of Swell Direction versus Swell Height (Grid Point 001329)

Source: Beaufort — Total Samples: 8080

Wave Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 - 1.0	3.22	4.21	5.88	7.82	13.35	13.39	7.08	6.13	3.97	2.41	3.02	4.65	7.54	6.72	3.63	4.02	97.04
1.0 - 2.0	0.02	0.07	0.06	0.05	0.30	0.35	0.10	0.01	0.00	0.00	0.00	0.11	0.61	0.84	0.30	0.01	2.83
2.0 - 3.0	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.12
3.0 - 4.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wave Direction (true / from)

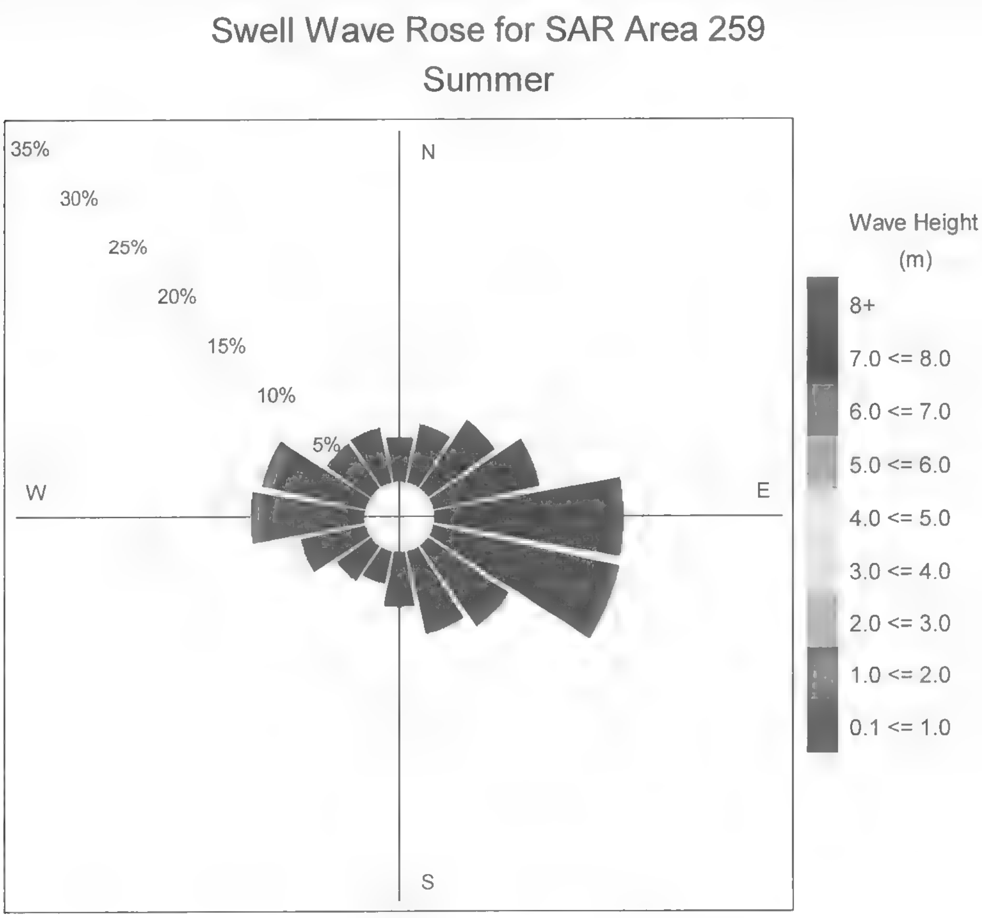

Figure 3.126 SAR Area 259 Summer Swell Rose Diagram (Grid Point 001329)

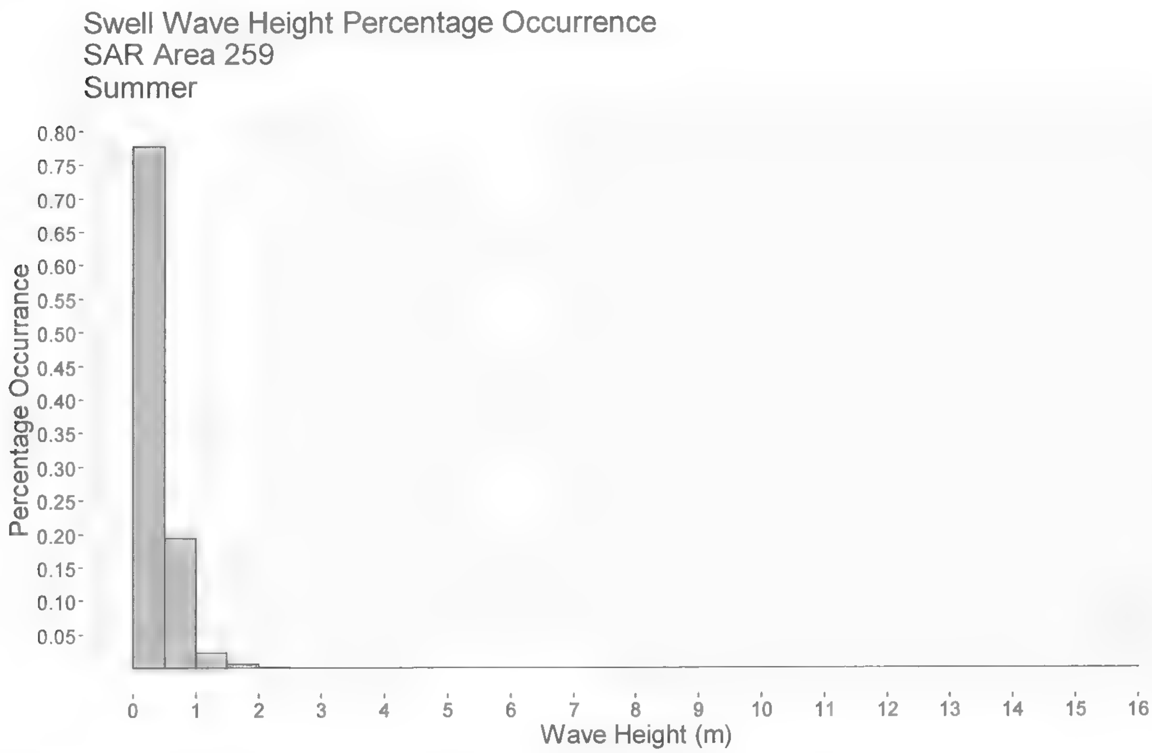

Figure 3.127 SAR Area 259 Summer Swell Height Percentage Occurrence (Grid Point 001329)

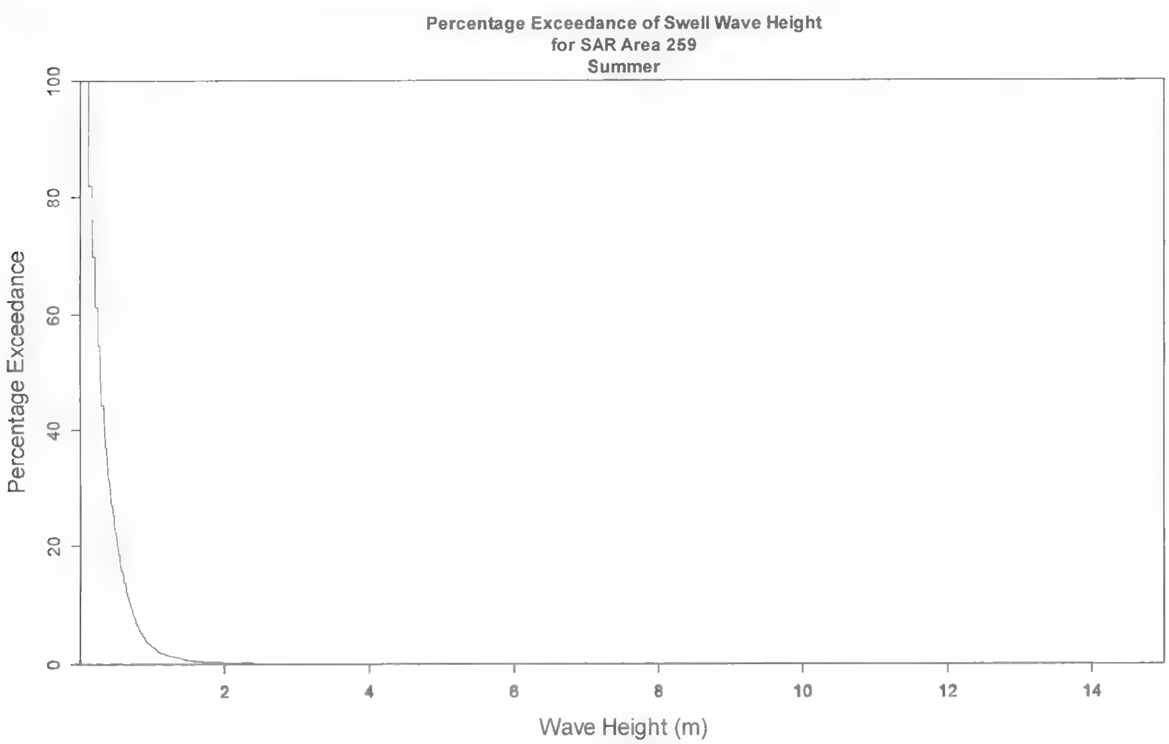

Figure 3.128 SAR Area 259 Summer Swell Height Percentage Exceedance (Grid Point 001329)

Table 3.63 SAR Area 259 Autumn Joint Percentage Frequency Distribution of Swell Direction versus Swell Wave Height (Grid Point 001329)

Source: Beaufort — Total Samples: 9593

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	3.22	2.79	3.61	4.21	9.00	11.61	8.24	7.55	5.97	3.24	3.28	4.48	7.32	5.24	3.95	3.04	86.76
	1.0 - 2.0	0.21	0.29	0.15	0.25	1.95	3.08	1.42	0.55	0.24	0.25	0.25	0.62	1.52	1.27	0.39	0.26	12.69
	2.0 - 3.0	0.00	0.00	0.00	0.00	0.00	0.22	0.09	0.00	0.02	0.00	0.00	0.01	0.06	0.09	0.05	0.00	0.55
	3.0 - 4.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

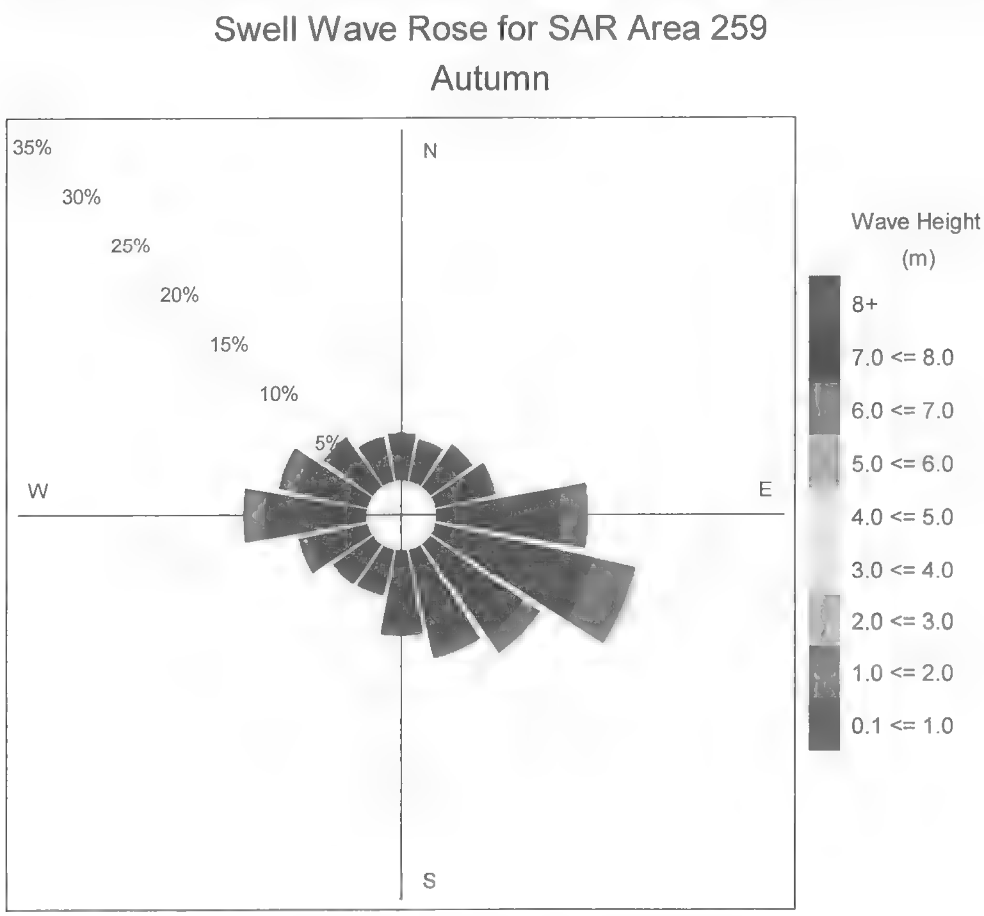

Figure 3.129 SAR Area 259 Autumn Swell Rose Diagram (Grid Point 001329)

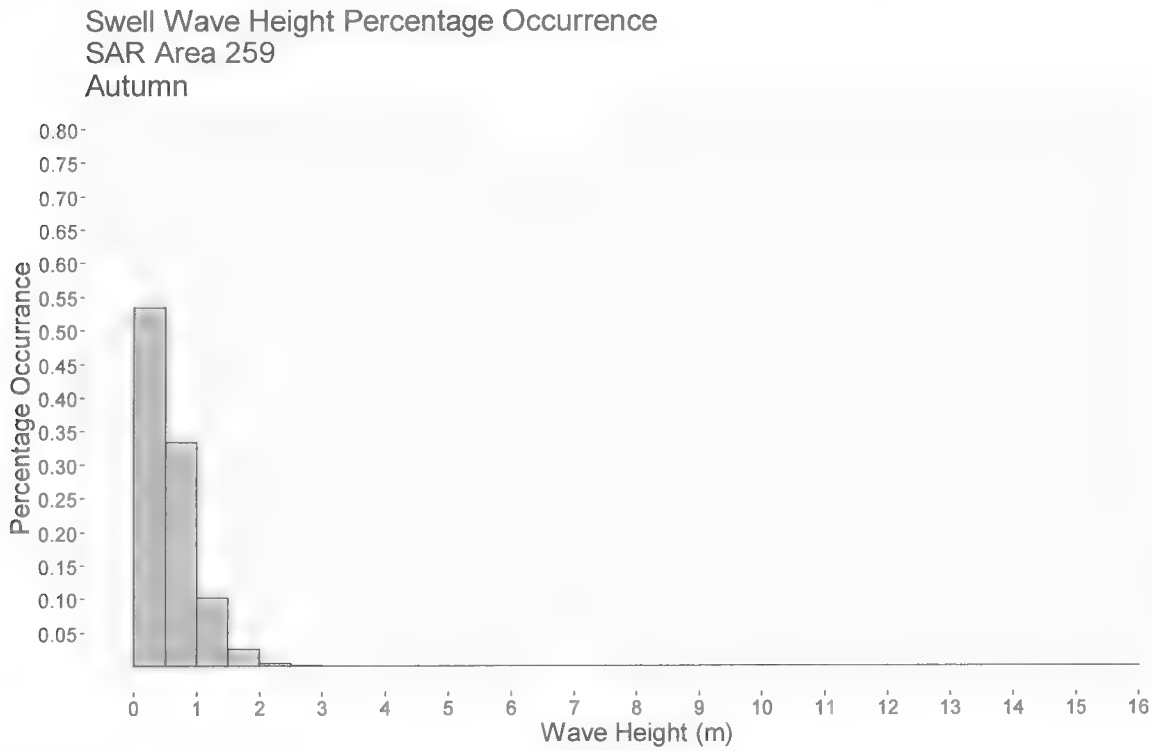

Figure 3.130 SAR Area 259 Autumn Swell Height Percentage Occurrence (Grid Point 001329)

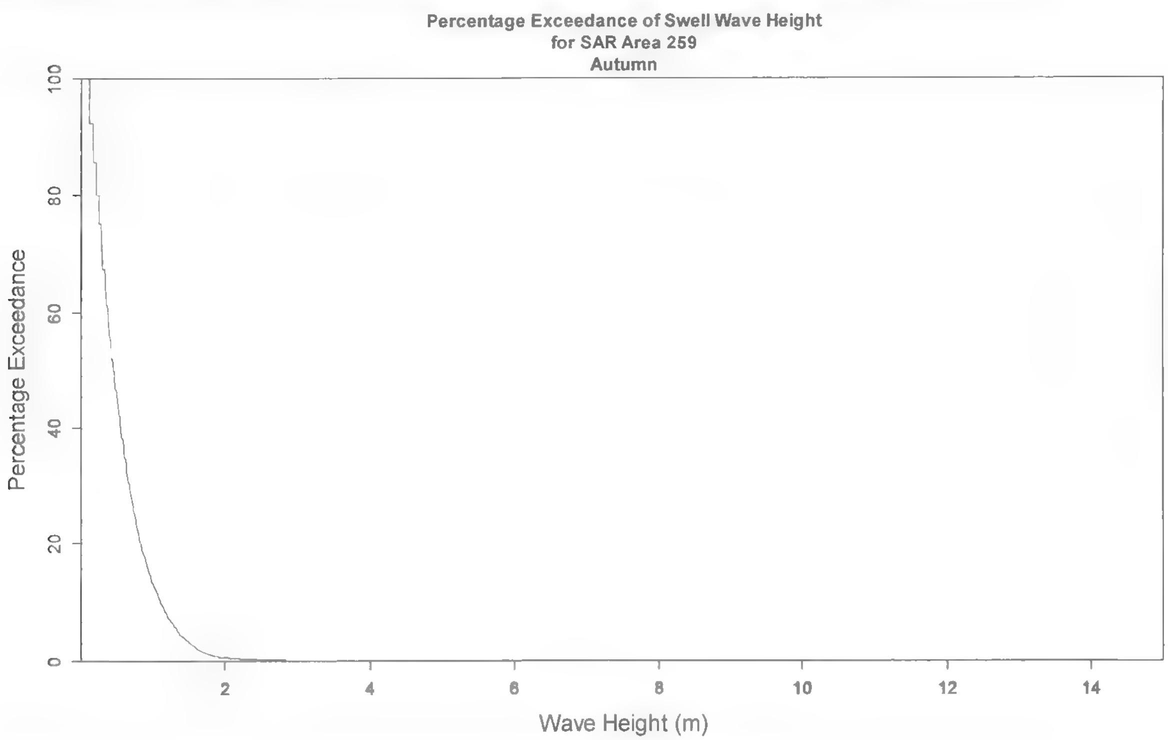

Figure 3.131 SAR Area 259 Autumn Swell Height Percentage Exceedance (Grid Point 001329)

3.3.3 *Air and Sea Surface Temperature*

Air temperature statistics were obtained from the ISD data base while sea surface temperatures for the area were extracted from the ICOADS data set for SAR Area 259. Seasonal plots of air temperature versus sea surface temperature are presented in Figure 3.132. Air and sea surface temperature statistics are presented in Table 3.64. The atmosphere is coldest in January with a mean air temperature of -23.5°C, and warmest during July with a mean air temperature of 15.1°C. Based on this, the southern portion of SAR Area 259 would be classified as sub-arctic.

The mean maximum and mean minimum temperature statistics were calculated by determining the seasons maximum and minimum for each year, then averaging over the number of years of data. These statistics are presented in Table 3.65.

Sea surface temperature statistics can vary greatly over the region with July temperatures ranging from -2°C in the northern part of Hudson Bay, to 10°C to the south (Environment and Climate Change Canada, 2017).

Due to the presence of sea ice, sea surface temperature statistics are not available for all periods.

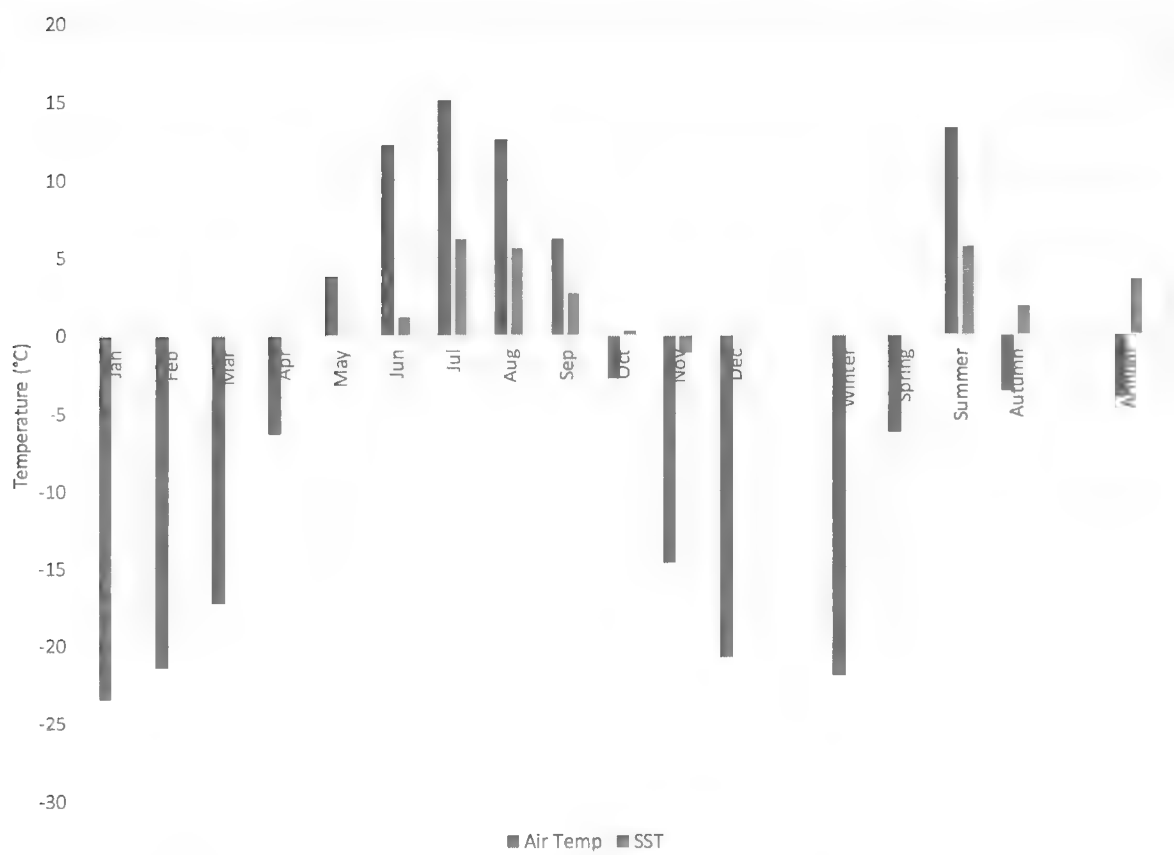

Figure 3.132 Monthly, Seasonal and Annual Mean Air and Sea Surface Temperature (°C) SAR Area 259 (ICOADS data set)

Table 3.64 Temperature (°C) Statistics for SAR Area 259

	Air Temperature (°C)				Sea Surface Temperature (°C)			
Month	Mean	Maximum	Minimum	Standard Deviation	Mean	Maximum	Minimum	Standard Deviation
January	-23.5	11.0	-49.0	8.2	NA	NA	NA	NA
February	-21.4	13.0	-47.0	8.5	NA	NA	NA	NA
March	-17.3	15.0	-45.0	9.4	NA	NA	NA	NA
April	-6.3	26.0	-40.0	9.6	NA	NA	NA	NA
May	3.8	32.0	-26.2	8.5	NA	NA	NA	NA
June	12.3	34.0	-11.1	7.5	1.2	4.0	-1.7	1.2
July	15.1	36.0	-11.1	6.4	6.2	18.2	-0.8	5.2
August	12.6	39.0	-11.1	6.2	5.6	15.0	-2.5	4.0
September	6.2	29.0	-13.0	5.8	2.7	11.6	-2.7	3.3
October	-2.8	24.0	-29.5	6.0	0.3	6.7	-2.0	1.7
November	-14.7	19.0	-44.8	7.6	-1.2	-0.8	-1.7	0.3
December	-20.8	14.0	-49.0	7.9	NA	NA	NA	NA
Winter	-21.9	14.0	-49.0	8.3	NA	NA	NA	NA
Spring	-6.2	32.0	-45.0	12.6	11.4	14.7	-1.4	6.5
Summer	13.3	39.0	-11.1	6.8	5.7	18.2	-2.5	4.4
Autumn	-3.6	29.0	-44.8	10.7	1.9	11.6	-2.7	3.1
Annual	-4.0	39.0	-49.0	15.8	3.6	22.5	-2.7	4.2

Table 3.65 Mean Maximum and Mean Minimum Temperature (°C) Statistics for SAR Area 259

	Air Temperature (°C)		Sea Surface Temperature (°C)	
Month	Mean Maximum	Mean Minimum	Mean Maximum	Minimum Standard Deviation
January	1.0	-44.1	NA	NA
February	3.5	-42.5	NA	NA
March	8.9	-40.5	NA	NA
April	18.3	-32.2	7.9	7.9
May	27.0	-19.5	NA	NA
June	30.3	-4.6	4.0	-1.7
July	31.8	-0.4	14.7	2.0
August	30.8	-1.4	11.6	-0.1
September	24.8	-7.9	7.8	-1.2
October	17.1	-22.5	2.8	-0.8
November	4.7	-36.2	-0.8	-1.7
December	1.2	-41.4	NA	NA
Winter	6.3	-44.9	NA	NA
Spring	27.0	-40.5	4.8	4.8
Summer	32.5	-4.7	14.4	-0.5
Autumn	24.9	-36.3	7.8	-1.4
Annual	32.6	-44.9	15.3	-1.5

3.3.4 Sea Ice

Frequency of Presence

A weekly analysis of the Canadian Ice Service's Frequency of Presence of Sea Ice for the period of 1981 to 2010 was determined for SAR Area 259. These results are presented in Table 3.66 and Figure 3.133. Charts were unavailable for weeks which show no data.

These statistics show that the region is affected by sea ice throughout the year. The Frequency of Presence is highest the weeks beginning January 01 and January 29. A map depicting the frequency of presence of sea ice for the week of January 29 is presented in Figure 3.134. It should be noted that there is an area of SAR Area 259 to the northwest which is not covered by the Arctic Sea Ice charts. The statistics provided below are for the area of coverage.

Table 3.66 Frequency of Presence of Sea Ice within SAR Area 259 (1981 - 2010)

	Ice Free	1-15%	16-33%	34-50%	51-66%	67-84%	85-99%	100%
Jan-01	0.00	0.00	0.03	0.02	0.00	0.00	0.29	99.66
Jan-08								
Jan-15								
Jan-22								
Jan-29	0.00	0.00	0.03	0.02	0.00	0.00	0.30	99.66
Feb-05								
Feb-12								
Feb-19								
Feb-26	0.00	0.00	0.03	0.02	0.00	0.00	0.65	99.31
Mar-05								
Mar-12								
Mar-19								
Mar-26								
Apr-02	0.00	0.00	0.04	0.03	0.00	0.00	1.00	98.92
Apr-09								
Apr-16								
Apr-23								
Apr-30	0.00	0.00	0.03	0.02	0.00	0.06	15.42	84.48
May-07								
May-14	0.00	0.00	0.00	0.05	0.00	2.78	28.03	69.14
May-21								
May-28								
Jun-04	0.00	0.00	0.00	0.28	2.94	15.58	23.29	57.89
Jun-11	0.00	0.00	0.04	1.53	4.27	15.80	20.47	57.89
Jun-18	0.00	0.00	0.32	2.12	5.43	21.81	24.75	45.57
Jun-25	0.00	0.41	0.31	0.68	9.49	20.83	25.54	42.73
Jul-02	0.30	0.52	0.37	1.17	12.70	22.99	21.71	40.24
Jul-09	0.00	0.97	0.81	3.41	14.72	20.33	20.30	39.46
Jul-16	0.63	0.99	2.50	7.92	15.44	14.73	19.37	38.41
Jul-23	0.88	1.68	5.53	12.53	8.95	12.57	22.79	35.06
Jul-30	1.35	2.30	13.08	9.06	4.30	10.16	20.47	39.28
Aug-06	2.11	6.16	13.66	4.64	3.86	10.83	25.41	33.33
Aug-13	2.41	11.70	9.70	4.95	3.50	10.86	22.25	34.62
Aug-20	2.59	11.45	9.55	6.24	4.84	13.23	22.09	30.02
Aug-27	2.81	10.73	10.30	6.61	5.00	12.47	24.30	27.79
Sep-03	3.14	10.89	12.47	4.81	4.27	11.86	24.39	28.17
Sep-10	3.83	11.23	12.57	4.72	4.25	13.48	25.69	24.23

Sep-17	4.58	12.82	11.06	4.82	3.45	11.45	23.05	28.76
Sep-24	4.26	12.93	11.71	4.94	3.70	7.24	26.23	29.00
Oct-01	3.55	7.58	14.51	6.10	4.31	7.46	17.32	39.17
Oct-08	0.05	6.72	12.02	9.83	5.04	6.90	14.97	44.48
Oct-15	0.00	0.34	7.43	5.46	11.61	12.42	19.54	43.20
Oct-22	0.00	0.00	0.04	6.87	4.87	17.80	15.34	55.08
Oct-29	0.00	0.00	0.04	0.02	0.00	12.71	26.08	61.16
Nov-05	0.00	0.00	0.03	0.02	0.00	0.01	28.92	71.02
Nov-12	0.00	0.00	0.03	0.02	0.00	0.00	18.68	81.27
Nov-19	0.00	0.00	0.03	0.02	0.00	0.00	2.48	97.47
Nov-26	0.00	0.00	0.03	0.02	0.00	0.00	0.93	99.02
Dec-04	0.00	0.00	0.03	0.02	0.00	0.00	0.96	98.99

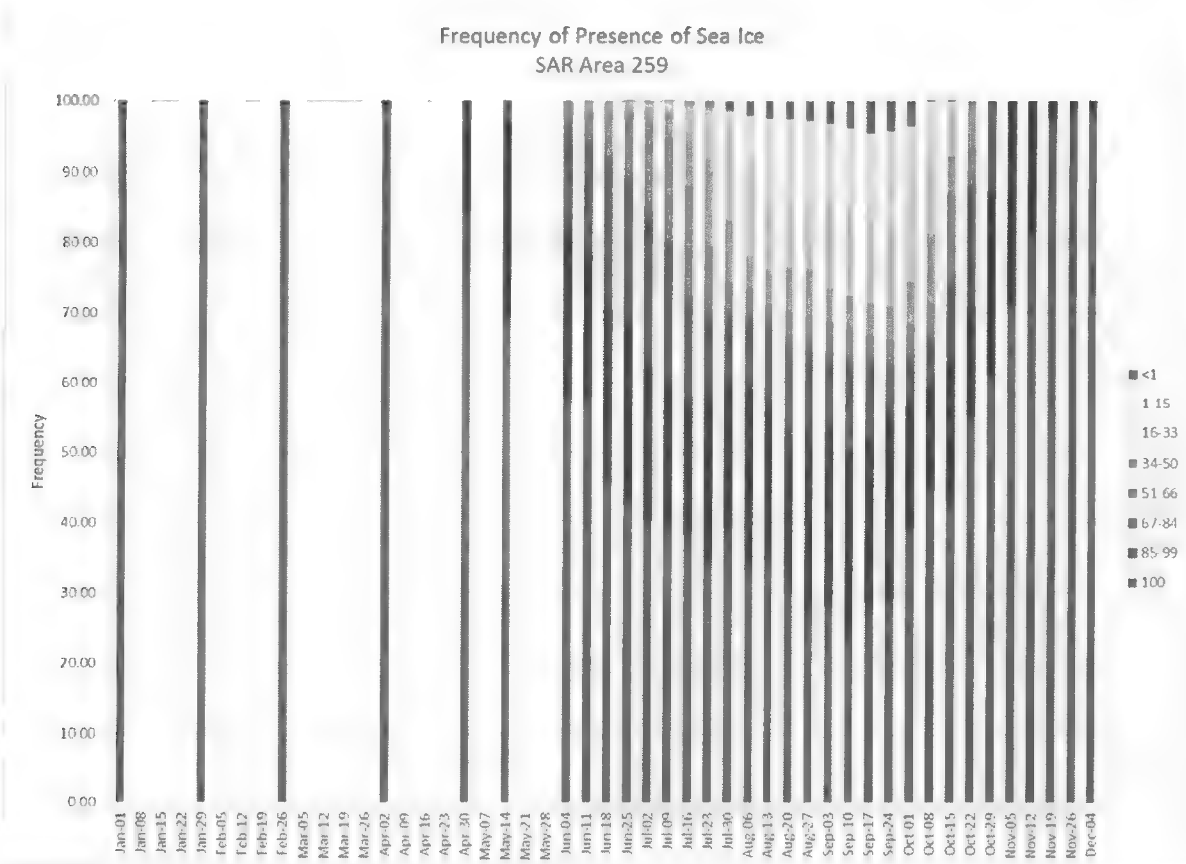

Figure 3.133 Plot of Frequency of Presence of Sea Ice within SAR Area 259 (1981 - 2010)

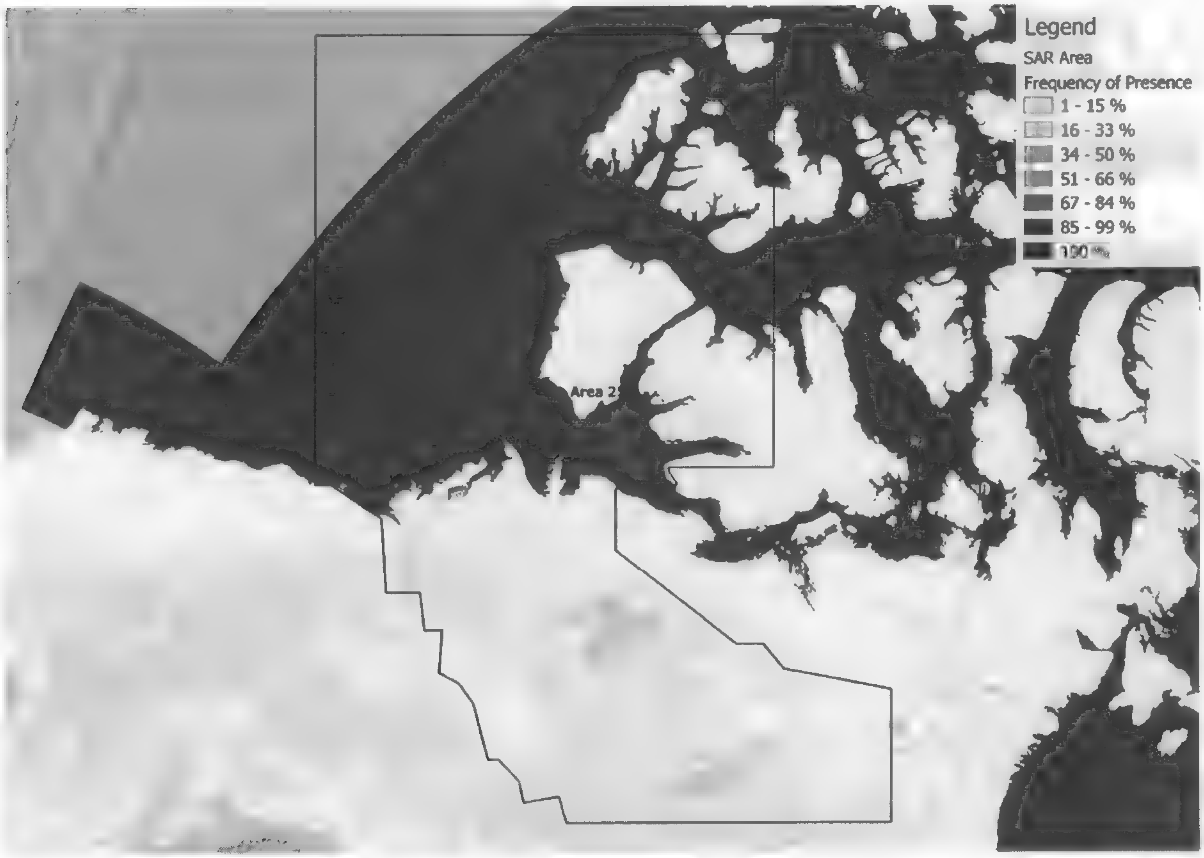

Figure 3.134 Frequency of Presence of Sea Ice for the week of January 29 within SAR Area 259 (1981 - 2010)

Median Concentration of Sea Ice

The region has sea ice concentrations of 9 tenths or greater from the weeks beginning October 29 through May 14. The week beginning April 02 has the highest coverage of 10 tenths sea ice concentration (Table 3.67 and Figure 3.135). Figure 3.136 depicts the median concentration of sea ice for the week of April 02.

Table 3.67 Median Concentration of Sea Ice within SAR Area 259 (1981 - 2010)

	Ice Free	1/10 - 3/10	4/10 - 6/10	7/10 - 8/10	9/10 - 9+/10	10/10	Total Ice
Jan-01	0.00	0.00	0.00	0.00	75.25	24.75	100.00
Jan-08							
Jan-15							
Jan-22							
Jan-29	0.00	0.00	0.00	0.00	74.03	25.97	100.00
Feb-05							
Feb-12							
Feb-19							
Feb-26	0.00	0.00	0.00	0.00	70.40	29.60	100.00
Mar-05							
Mar-12							
Mar-19							
Mar-26							
Apr-02	0.00	0.00	0.00	0.00	65.61	34.39	100.00
Apr-09							
Apr-16							
Apr-23							
Apr-30	0.00	0.00	0.00	0.00	65.82	34.18	100.00
May-07							
May-14	0.00	0.00	0.00	0.00	66.13	33.87	100.00
May-21							
May-28							
Jun-04	0.00	0.00	0.45	0.18	66.70	32.67	100.00
Jun-11	0.00	0.18	0.45	0.10	66.06	33.21	100.00
Jun-18	0.00	0.72	0.50	2.23	63.55	33.00	100.00
Jun-25	0.00	0.07	1.59	2.90	64.23	31.22	100.00
Jul-02	0.30	1.04	2.50	6.37	63.39	26.41	99.70
Jul-09	0.00	1.03	7.84	4.43	66.67	20.02	100.00
Jul-16	0.63	2.99	9.37	3.57	65.93	17.51	99.37
Jul-23	0.88	5.70	8.05	5.44	66.55	13.38	99.12
Jul-30	1.35	7.62	10.42	6.44	64.22	9.95	98.65
Aug-06	2.11	10.27	10.59	6.69	64.03	6.31	97.89
Aug-13	2.42	8.52	11.20	6.01	66.37	5.48	97.58
Aug-20	2.59	9.27	10.67	5.39	67.03	5.05	97.41
Aug-27	2.82	11.60	10.84	6.36	65.94	2.45	97.18
Sep-03	3.16	10.06	15.45	9.04	61.51	0.77	96.84

Sep-10	3.96	10.15	16.06	5.06	64.32	0.45	96.04
Sep-17	4.59	12.06	9.54	9.27	64.15	0.38	95.41
Sep-24	4.27	7.66	11.44	8.66	67.54	0.43	95.73
Oct-01	3.55	4.13	4.52	7.12	80.11	0.58	96.45
Oct-08	0.05	1.73	2.28	2.70	91.58	1.66	99.95
Oct-15	0.00	0.00	0.27	3.26	92.07	4.40	100.00
Oct-22	0.00	0.00	0.77	0.19	91.66	7.37	100.00
Oct-29	0.00	0.00	0.00	0.00	90.58	9.41	100.00
Nov-05	0.00	0.00	0.00	0.00	89.21	10.79	100.00
Nov-12	0.00	0.00	0.00	0.00	87.73	12.27	100.00
Nov-19	0.00	0.00	0.00	0.00	86.53	13.47	100.00
Nov-26	0.00	0.00	0.00	0.00	85.10	14.90	100.00
Dec-04	0.00	0.00	0.00	0.00	82.18	17.82	100.00

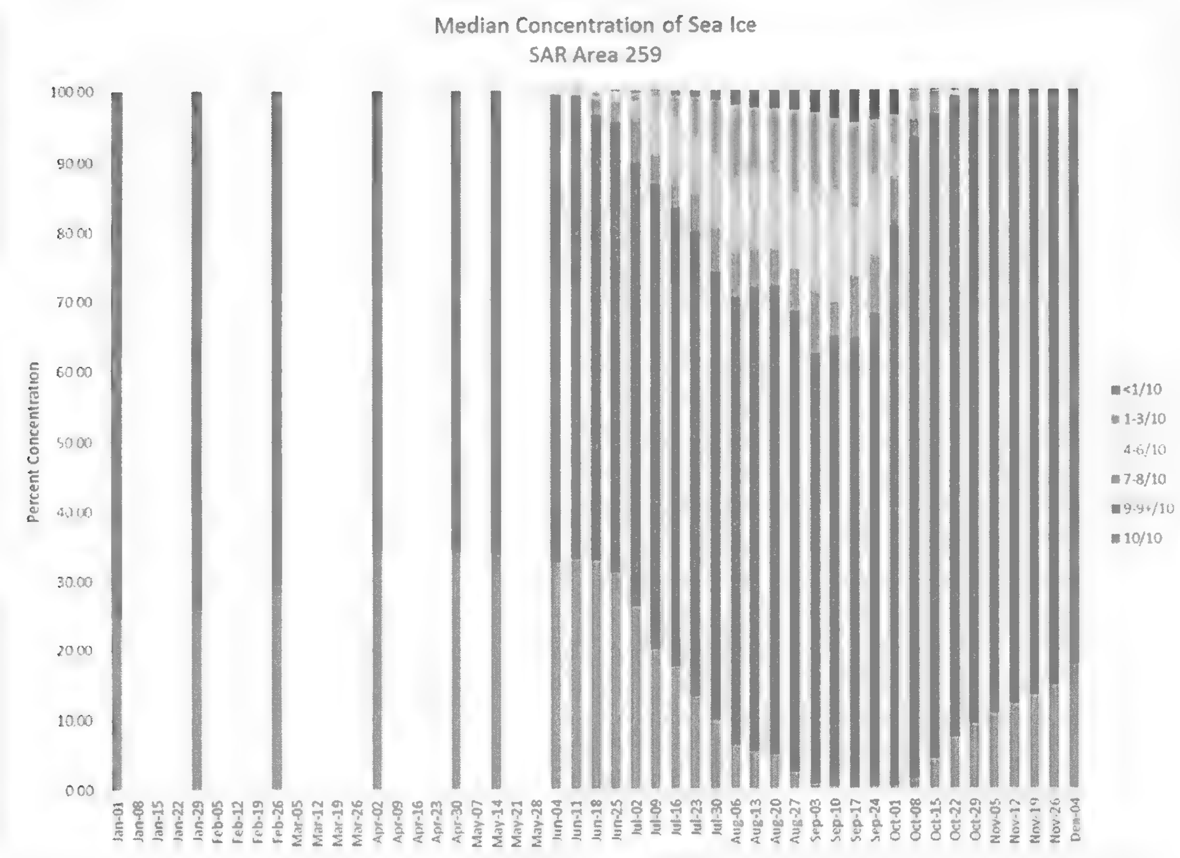

Figure 3.135 Plot of Median Concentration of Sea Ice within SAR Area 259 (1981 - 2010)

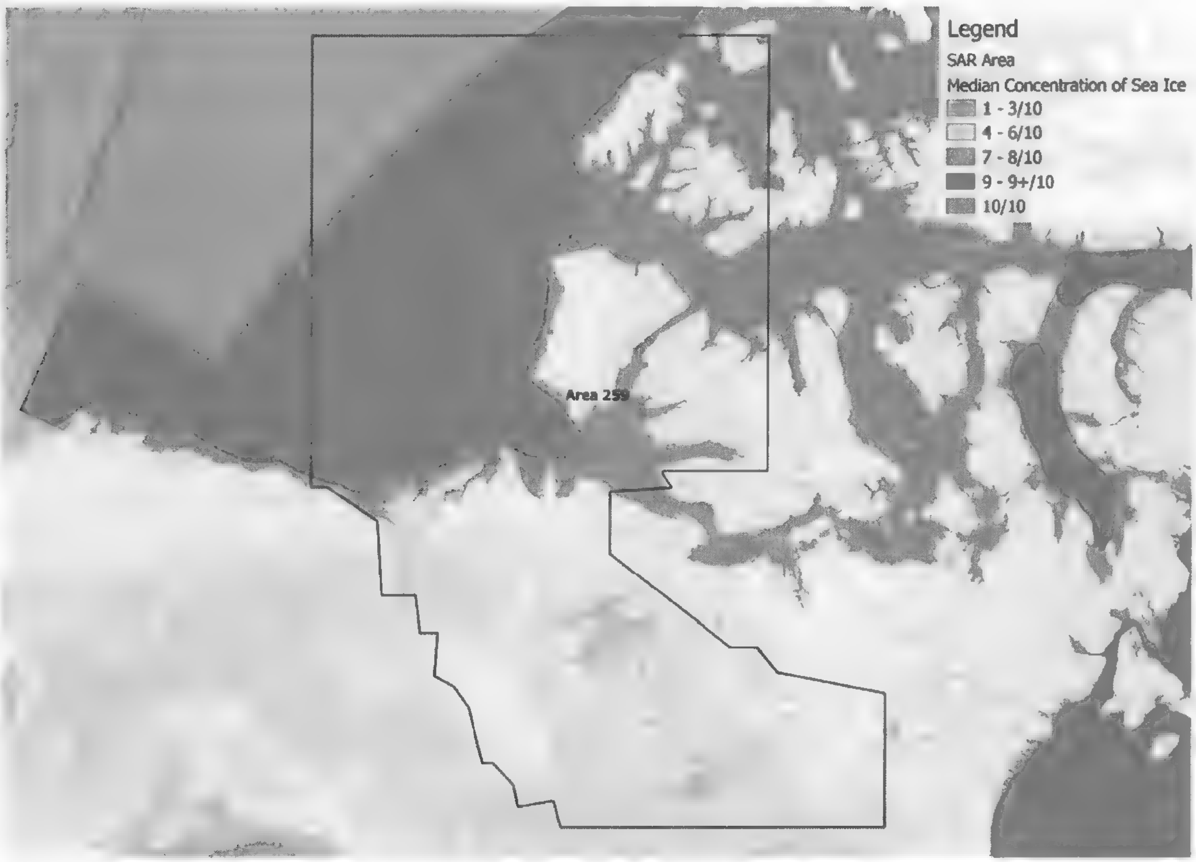

Figure 3.136 Median Concentration of Sea Ice for the week of April 02 within SAR Area 259 (1981 - 2010)

Predominant Ice Type

The presence of thick sea ice occurs within SAR Area 259 throughout the year. The weeks of November 19 through May 14 has the highest concentration of thick sea ice with 100.0% of the region covered in ice at least 15 cm thick and a concentration of 7 tenths or greater.

A chart depicting the predominant ice type when ice is present for the week of February 26 is provided below in Figure 3.137.

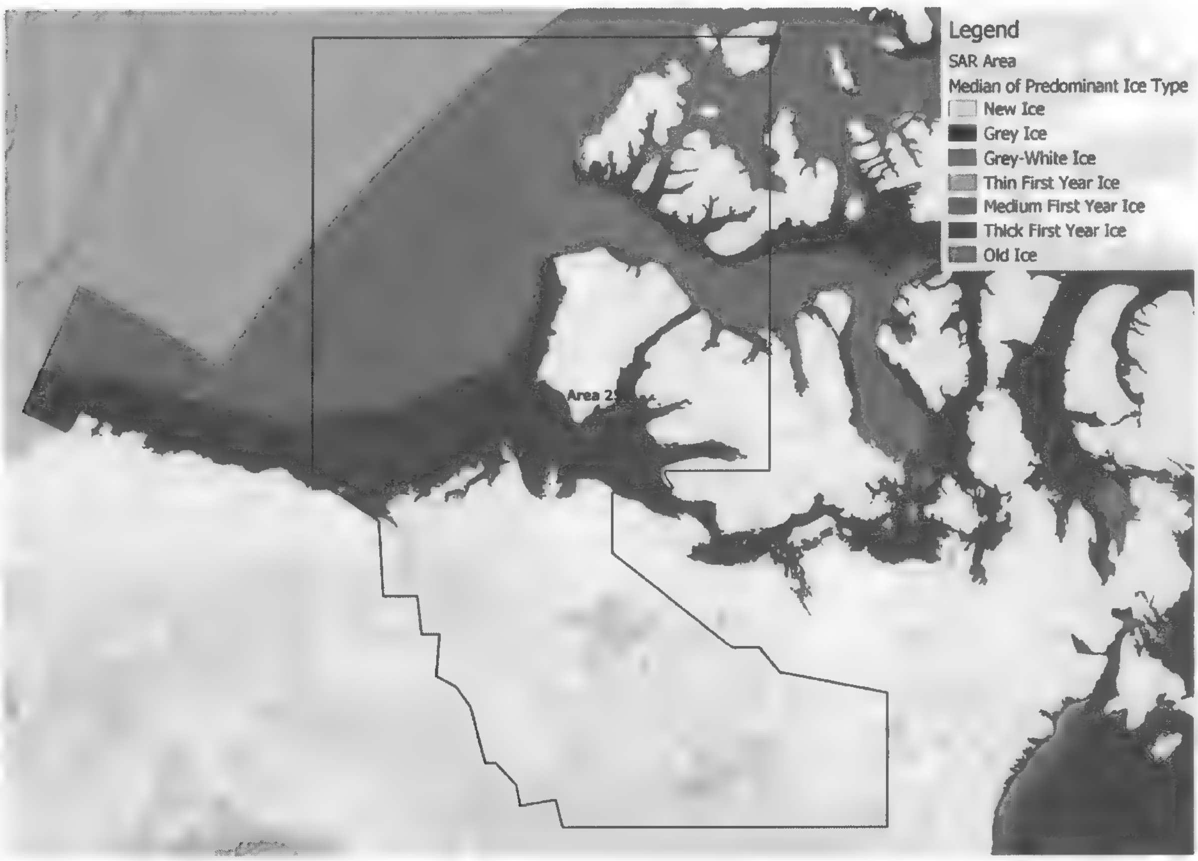

Figure 3.137 Median of Predominant Ice Type when Ice is Present (April 02)

3.3.5 *Summary Climate Statistics*

Table 3.68 Area 259 Summary Climate Statistics

Parameter	Description	Winter			Spring			Summer			Autumn		
Wind Direction	Prevailing Wind Direction	N			NE			NE			ENE		
Wind Speed	Mean Seasonal (knots)	11.8			11.2			10.2			13.3		
	Mean Seasonal Maximum (kts)	30.5			26.8			25.0			31.3		
Significant Wave Height	Percentage Frequency > 2.0 m	NA			NA			4.8			23.9		
Air Temperature	Mean Temperature (°C)	NA			NA			3.1			-7.4		
Sea Surface Temperature	Mean Seasonal Maximum Temperature (°C)	NA			NA			14.4			7.8		
	Mean Seasonal Minimum Temperature (°C)	NA			NA			-0.5			-1.4		
Seasonal Sea Ice Coverage	Mean Days per Season of Ice with concentration > 7/10 and thickness > 15cm	90			92			92			91		
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	100			100			88.0			82.5		
Seasonal Sea Ice Type	New Ice										Y		
	Grey Ice										Y		
	Grey-White Ice	Y									Y		
	Thin First Year Ice	Y									Y		
	Medium First Year Ice	Y									Y		
	Thick First Year Ice	Y			Y			Y			Y		
	Old Ice	Y			Y			Y			Y		
		D	J	F	M	A	M	J	J	A	S	O	N
Monthly Lake Ice Coverage	Mean Days per Month of Ice with concentration > 7/10 and thickness > 15cm	31	31	28	NA	30	31	30	31	31	30	31	30
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	100	100	100	NA	100	100	99.0	88.1	76.8	72.7	76.5	99.7
Monthly Lake Ice Type	New Ice				NA						Y	Y	
	Grey Ice				NA						Y	Y	Y
	Grey-White Ice	Y			NA						Y	Y	Y
	Thin First Year Ice	Y	Y		NA							Y	Y
	Medium First Year Ice	Y	Y		NA								Y
	Thick First Year Ice		Y	Y	NA	Y	Y	Y	Y	Y	Y		
	Old Ice	Y	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	Y

3.4 SAR Area 260

3.4.1 Wind Speed and Direction

Wind speed statistics from the ISD and ICOADS data sets for SAR Area 260 are presented in Table 3.69 and Table 3.70. Annual wind speed vectors are provided in Figure 3.138. The highest absolute maximum wind speed of 45.1 knots was recorded in the ISD data set during the autumn season. Wind speeds from all ISD locations within Area 260 were combined to produced the statistics in Table 3.69.

Wind roses of the seasonal wind speed and direction, the associated histogram of the wind speed frequency and the wind speed percentage exceedance plots for the ISD data set are presented in Figure 3.140 through Figure 3.150.

The predominate wind speed throughout the year is a 0 – 10 knot northerly wind. During the winter months, the predominate wind shifts to a 0 – 10 knot southerly.

Gale force winds are more frequent during the winter months. Wind speeds greater than 30 knots occur 1.0% of the time during the winter months.

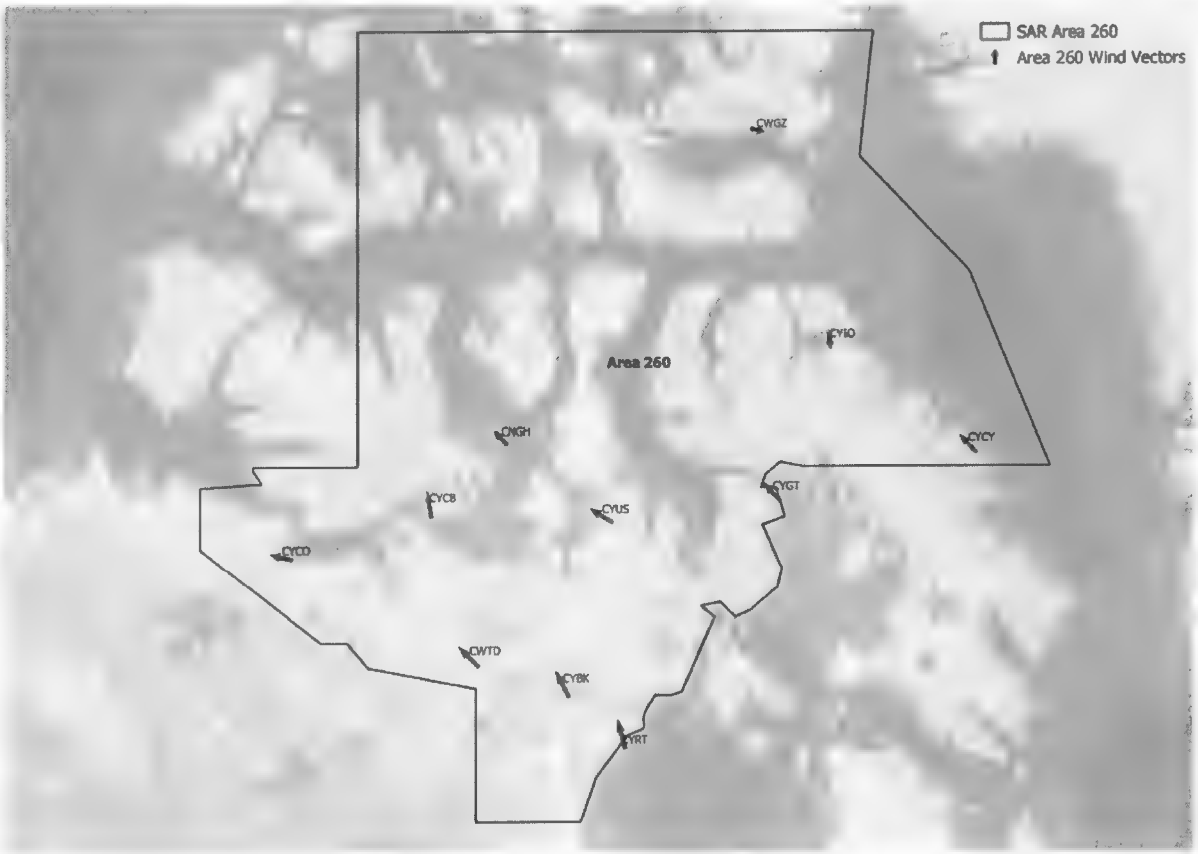

Figure 3.138 Annual Wind Vectors for SAR Area 260

Table 3.69 SAR Area 260 Seasonal Wind Speed Statistics from the ISD data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	10.4	6.9	40.5	41.0
Spring	9.9	6.2	36.7	36.9
Summer	9.1	5.3	32.1	32.9
Autumn	10.7	6.4	38.9	39.1

Table 3.70 SAR Area 260 Seasonal Wind Speed Statistics from the ICOADS data set (knots)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	NA	NA	NA	NA
Spring	NA	NA	NA	NA
Summer	11.5	6.8	37.4	42.0
Autumn	12.7	7.3	40.6	45.1

Table 3.71 SAR Area 260 Winter Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD — Total Samples: 607836

	Wind Direction (true / from)																
Wind Speed (knots)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 10	5.62	1.96	1.91	1.86	3.19	2.09	2.39	3.20	7.54	3.94	4.02	3.99	6.99	3.98	4.23	3.37	58.64
10 - 20	4.17	0.73	0.62	0.63	1.22	0.81	0.81	0.70	1.19	0.86	1.66	1.63	3.29	3.60	6.24	3.72	30.22
20 - 30	2.02	0.20	0.17	0.19	0.24	0.16	0.19	0.14	0.19	0.16	0.19	0.19	0.43	0.85	3.63	2.31	10.13
30 - 40	0.21	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.04	0.45	0.27	0.93
40 - 50	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.07
50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

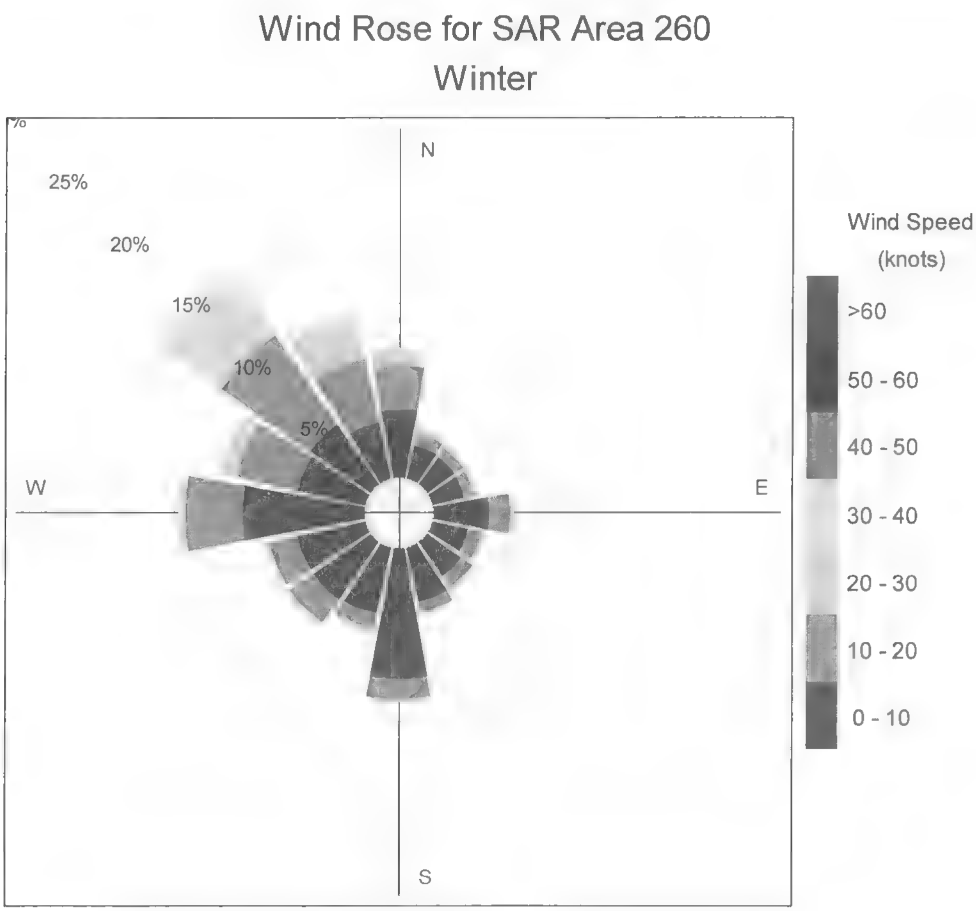

Figure 3.139 SAR Area 260 Winter Wind Rose (ISD)

Wind Speed Percentage Occurrence
SAR Area 260
Winter

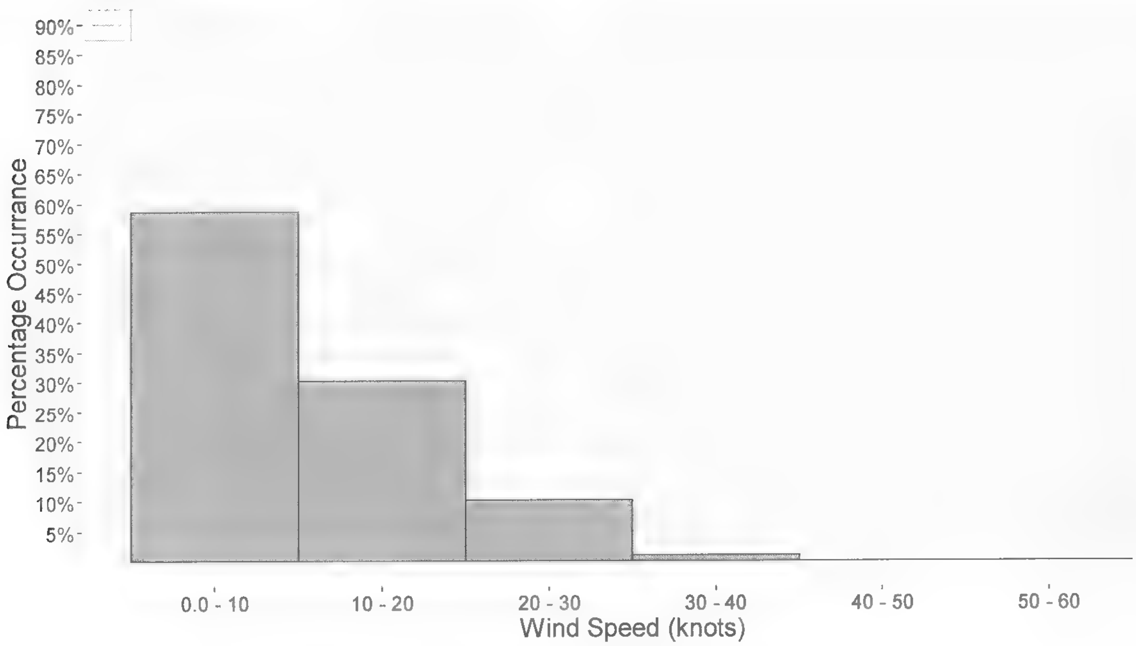

Figure 3.140 SAR Area 260 Winter Wind Speed Percentage Occurrence (ISD)

Percentage Exceedance of 10 metre Wind Speed
for SAR Area 260
Winter

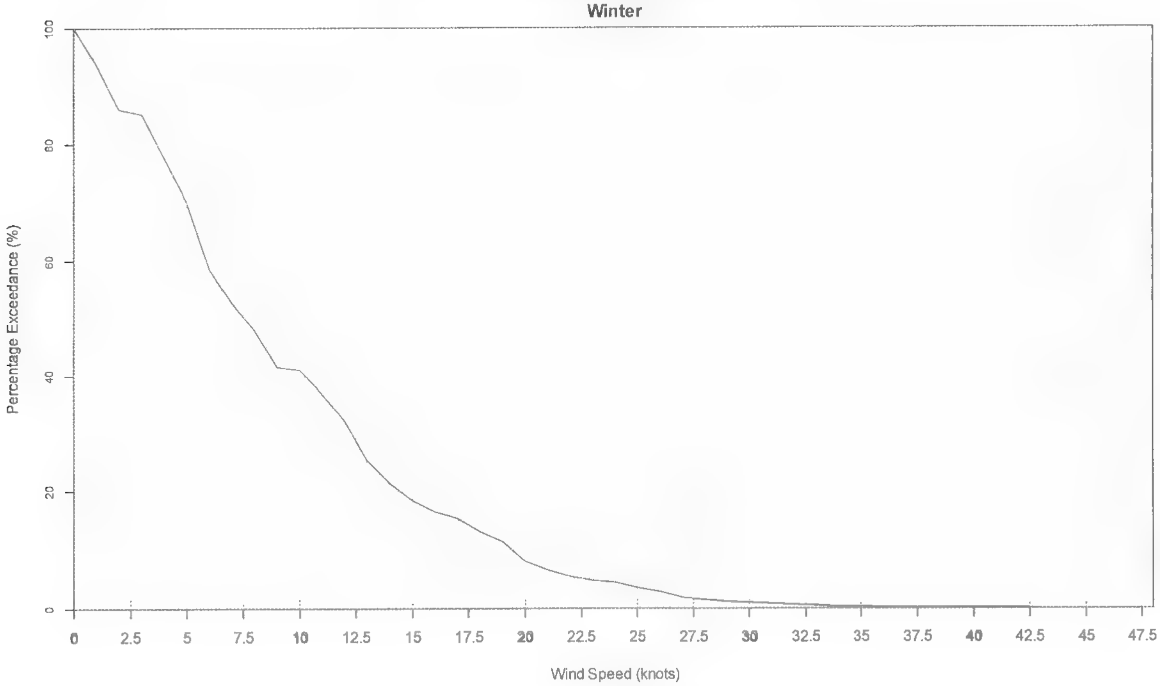

Figure 3.141 SAR Area 260 Winter Wind Speed Percentage Exceedance (ISD)

Table 3.72 SAR Area 260 Spring Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD

Total Samples: 629181

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	6.99	2.97	2.91	2.67	4.24	2.75	2.73	3.04	6.00	3.67	4.14	3.68	5.84	3.27	4.00	3.70	60.73
	10 - 20	4.41	1.28	1.30	1.26	2.28	1.41	1.46	0.87	1.25	0.85	1.22	1.03	2.49	2.82	5.19	3.41	30.98
	20 - 30	1.50	0.36	0.30	0.33	0.42	0.26	0.27	0.18	0.18	0.15	0.11	0.09	0.28	0.55	2.09	1.39	7.78
	30 - 40	0.09	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.03	0.20	0.11	0.47
	40 - 50	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

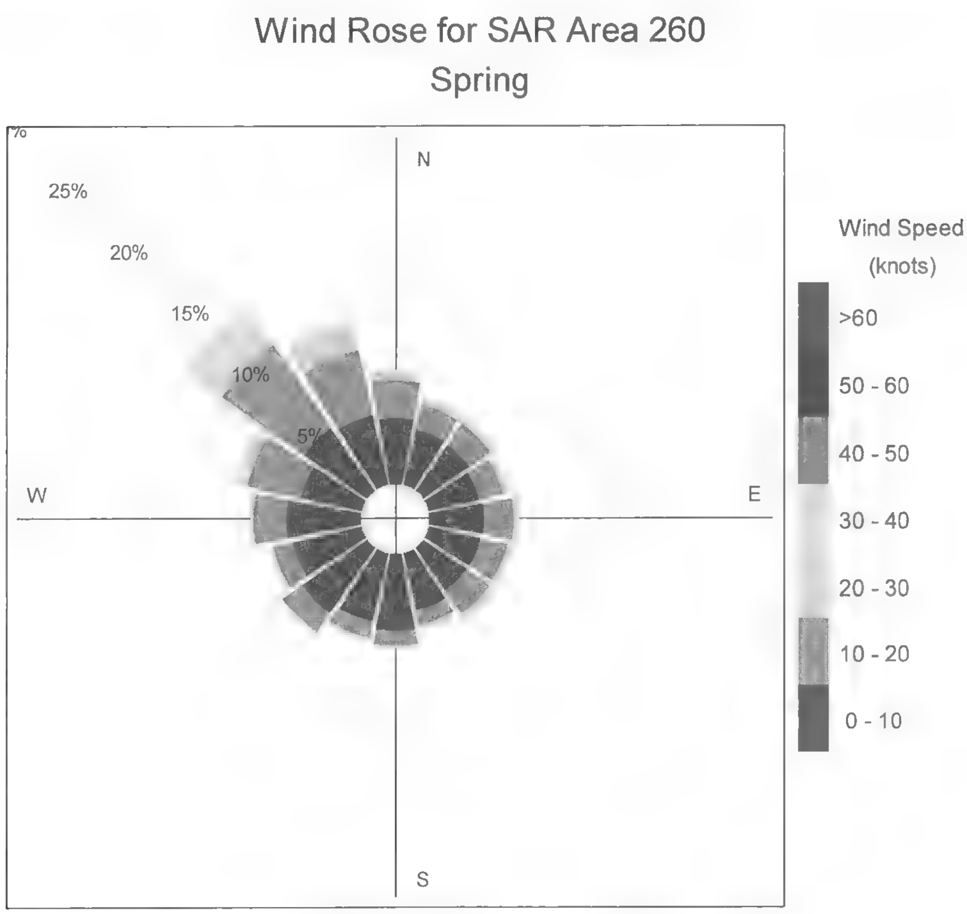

Figure 3.142 SAR Area 260 Spring Wind Rose Diagram (ISD)

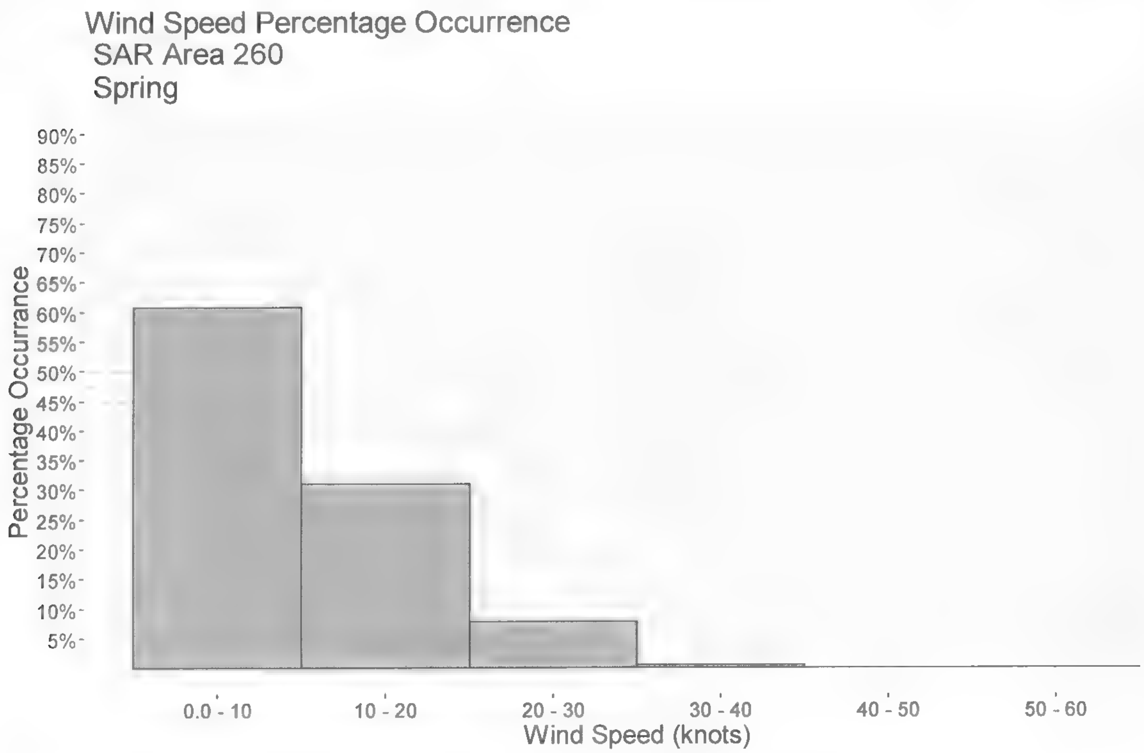

Figure 3.143 SAR Area 260 Spring Wind Speed Percentage Occurrence (ISD)

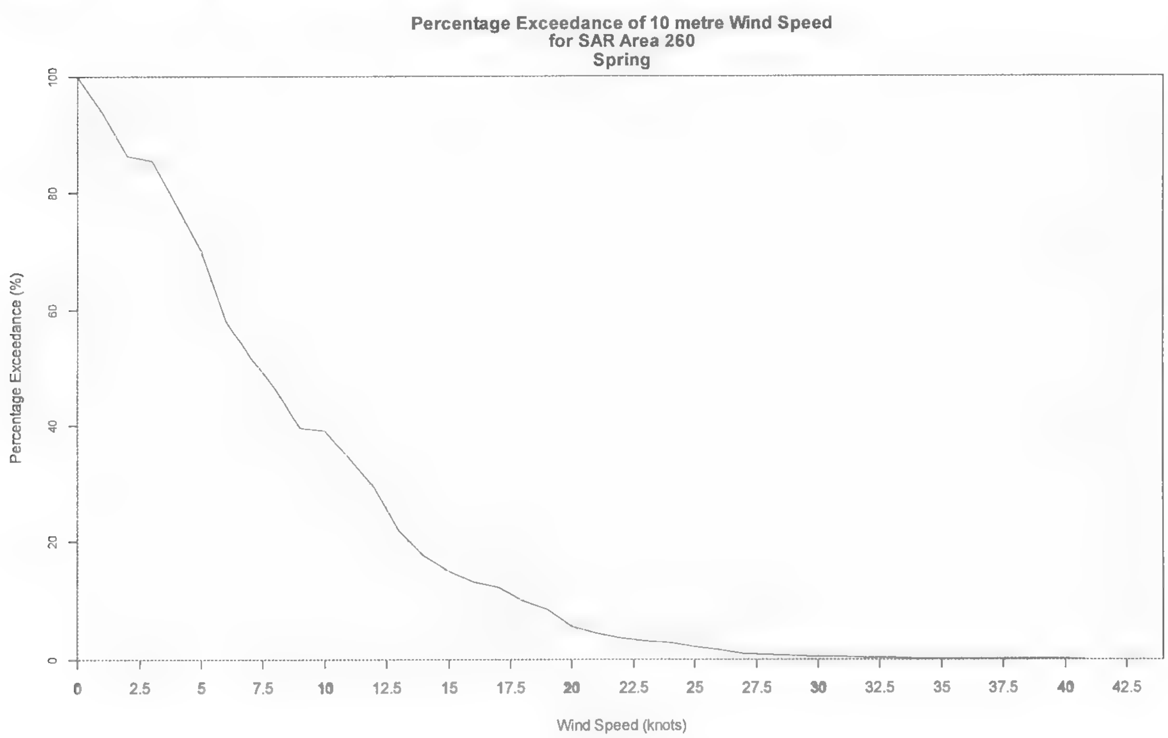

Figure 3.144 SAR Area 260 Spring Wind Speed Percentage Exceedance (ISD)

Table 3.73 SAR Area 260 Summer Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD Total Samples: 646305

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	8.53	3.79	4.04	3.87	5.91	4.39	3.04	2.21	3.50	2.94	4.08	4.42	6.03	3.23	3.59	4.07	65.50
	10 - 20	5.46	1.65	1.64	1.59	2.17	1.74	1.33	0.76	1.17	0.93	1.06	0.89	1.85	2.25	3.77	3.62	30.13
	20 - 30	0.86	0.24	0.22	0.22	0.22	0.11	0.12	0.06	0.07	0.08	0.08	0.06	0.18	0.44	0.94	0.64	4.24
	30 - 40	0.03	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.13
	40 - 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

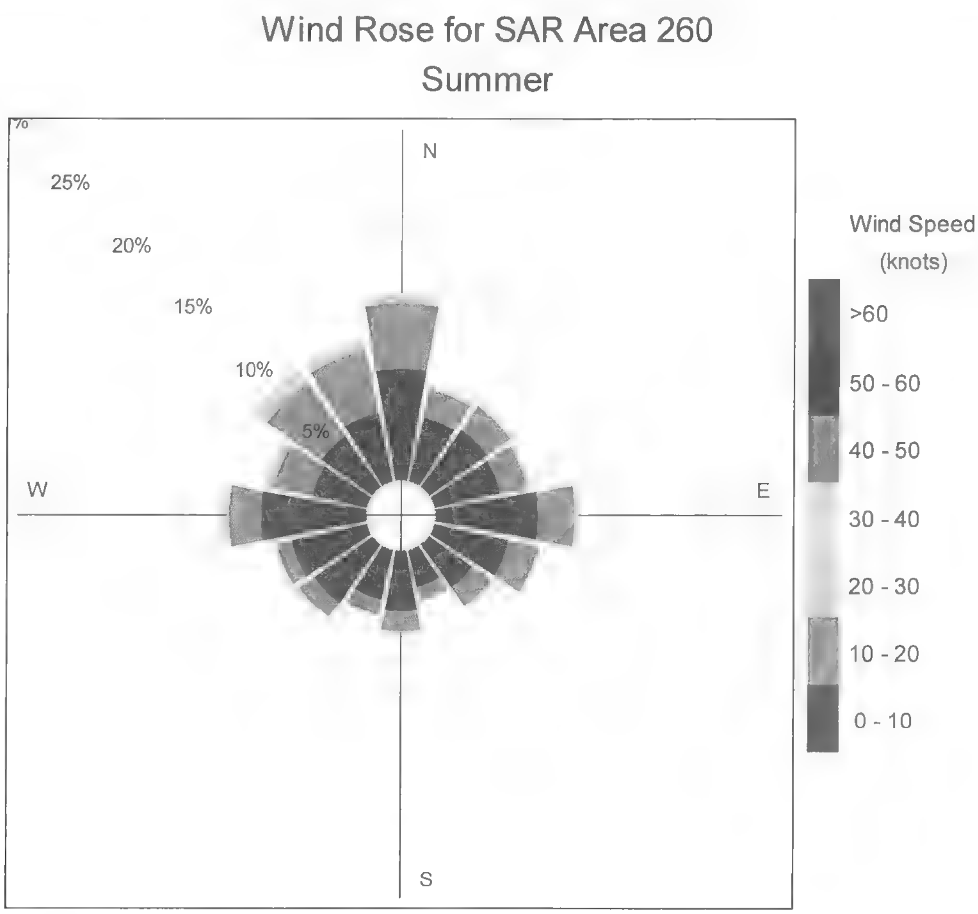

Figure 3.145 SAR Area 260 Summer Wind Rose Diagram (ISD)

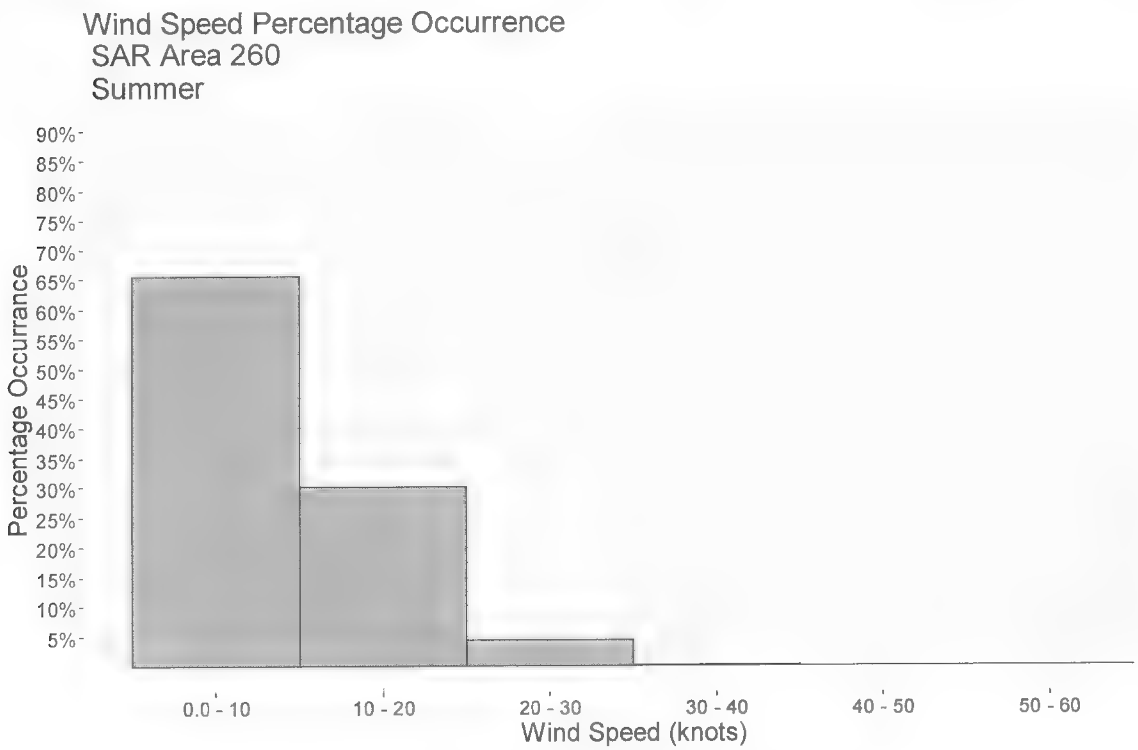

Figure 3.146 SAR Area 260 Summer Wind Speed Percentage Occurrence (ISD)

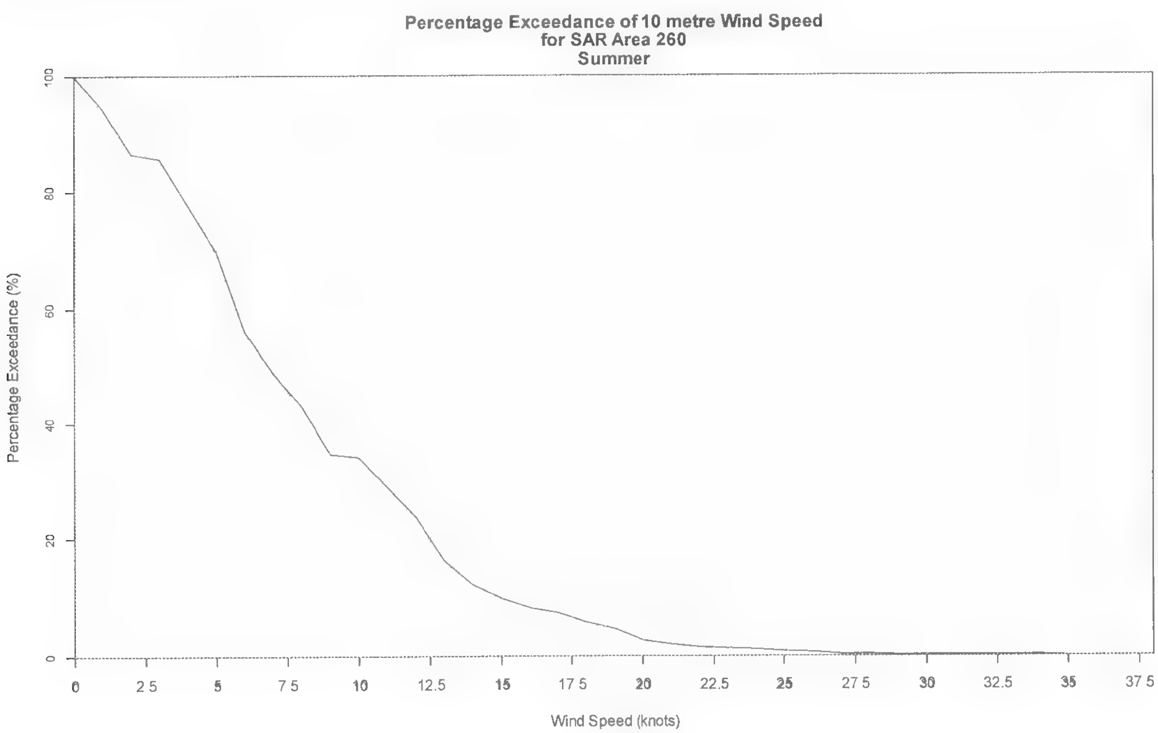

Figure 3.147 SAR Area 260 Summer Wind Speed Percentage Exceedance (ISD)

Table 3.74 SAR Area 260 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Speed (ISD)

Source: ISD Total Samples: 707581

		Wind Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wind Speed (knots)	0 - 10	6.43	2.32	2.43	2.57	3.89	2.68	3.30	4.16	5.03	2.57	2.72	2.81	5.47	3.73	3.98	3.56	55.85
	10 - 20	5.03	1.35	1.32	1.54	2.22	1.22	1.49	1.40	1.82	1.19	1.25	1.15	3.05	3.44	4.42	3.62	33.81
	20 - 30	1.75	0.40	0.36	0.44	0.56	0.32	0.40	0.34	0.37	0.23	0.21	0.13	0.56	0.87	1.91	1.44	9.64
	30 - 40	0.13	0.03	0.03	0.02	0.04	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.06	0.18	0.12	0.66
	40 - 50	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04
	50 - 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Rose for SAR Area 260
Autumn

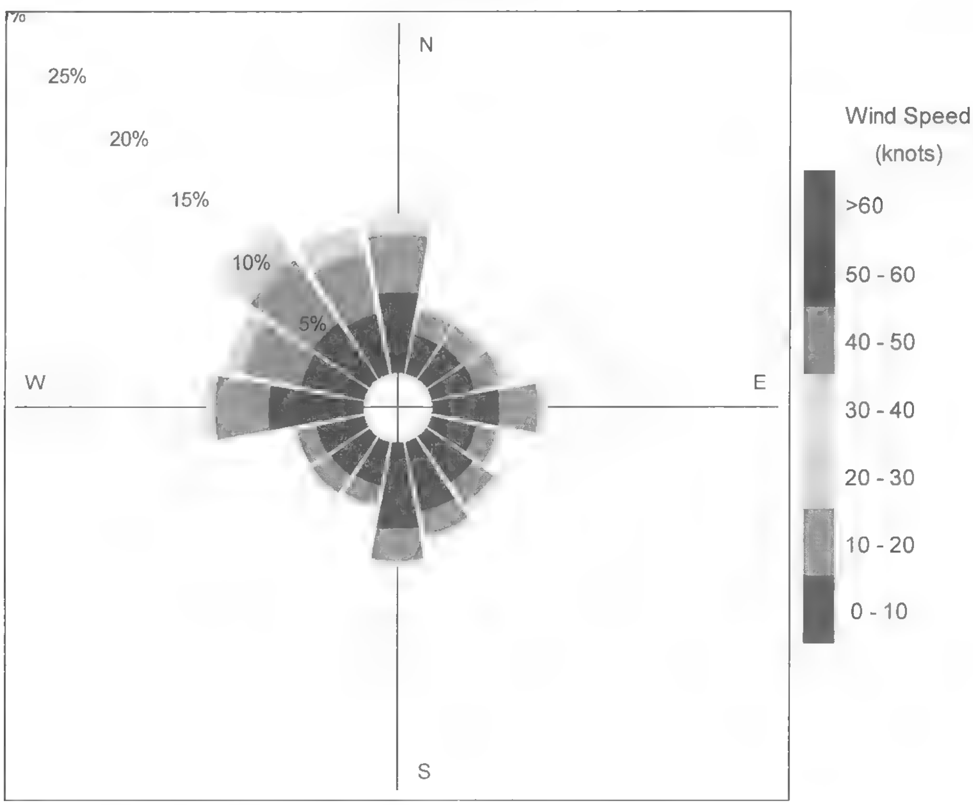

Figure 3.148 SAR Area 260 Autumn Wind Rose Diagram (ISD)

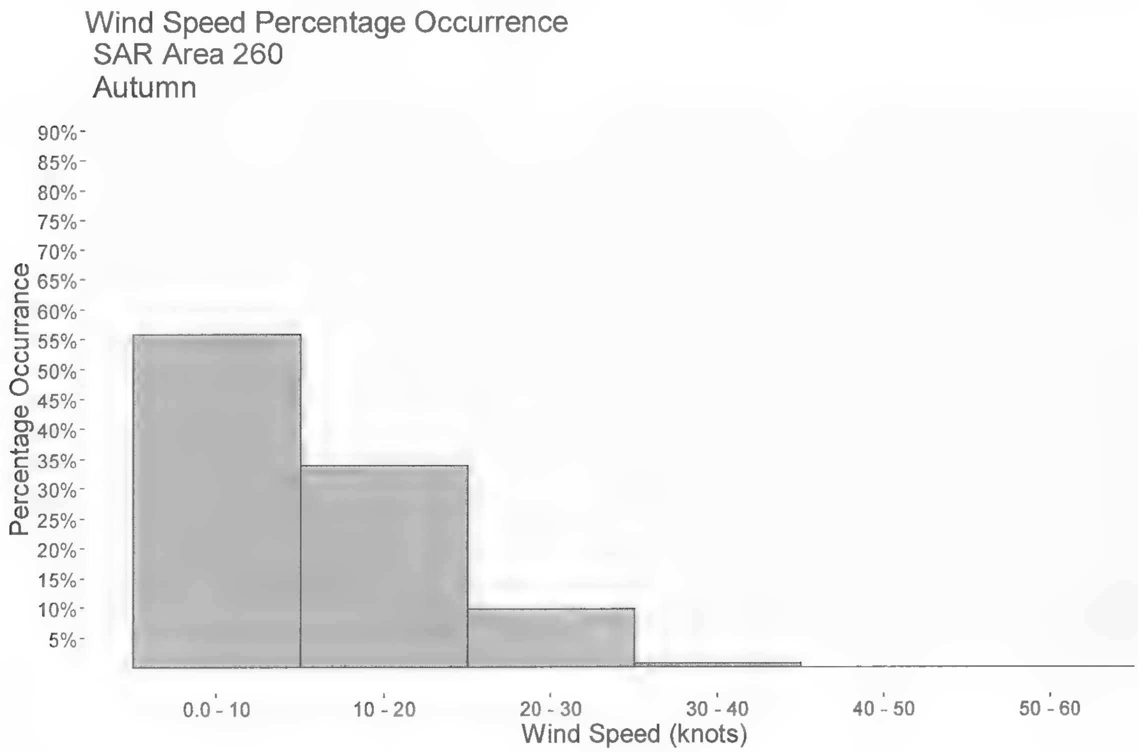

Figure 3.149 SAR Area 260 Autumn Wind Speed Percentage Occurrence (ISD)

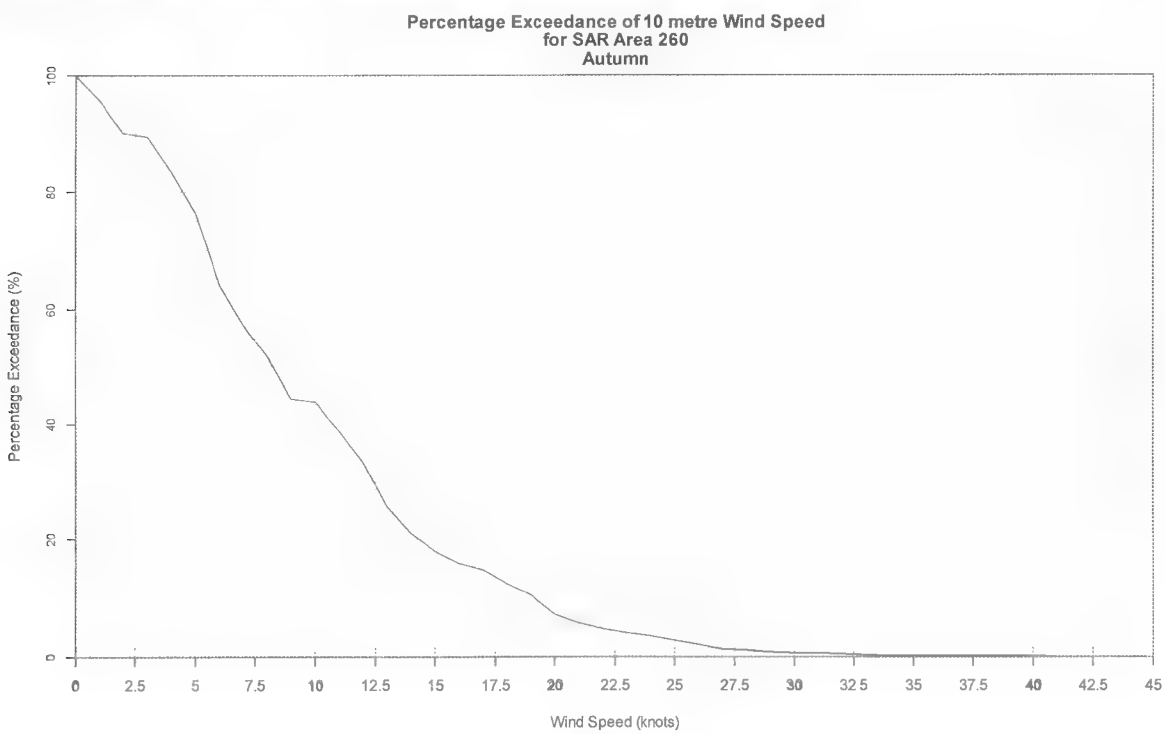

Figure 3.150 SAR Area 260 Autumn Wind Speed Percentage Exceedance (ISD)

3.4.2 *Wave Height*

Significant Wave Height

Due to the orientation of the topography and direction of the prevailing winds within SAR Area 260, wave directions over the region would primarily be from the north to south.

Seasonal mean, standard deviation, mean maximum and absolute maximum significant wave height statistics are provided in Table 3.75 for SAR Area 260.

There is insufficient directional data within the ICOADS wave data set to generate significant wave height wave roses or joint frequency of significant wave height and wave direction tables.

Table 3.75 SAR Area 260 Seasonal Significant Wave Height Statistics from ICOADS (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.6	1.0	2.2	5.0
Spring	1.7	1.3	2.7	6.5
Summer	0.9	0.6	3.0	4.9
Autumn	1.1	0.7	3.8	4.9

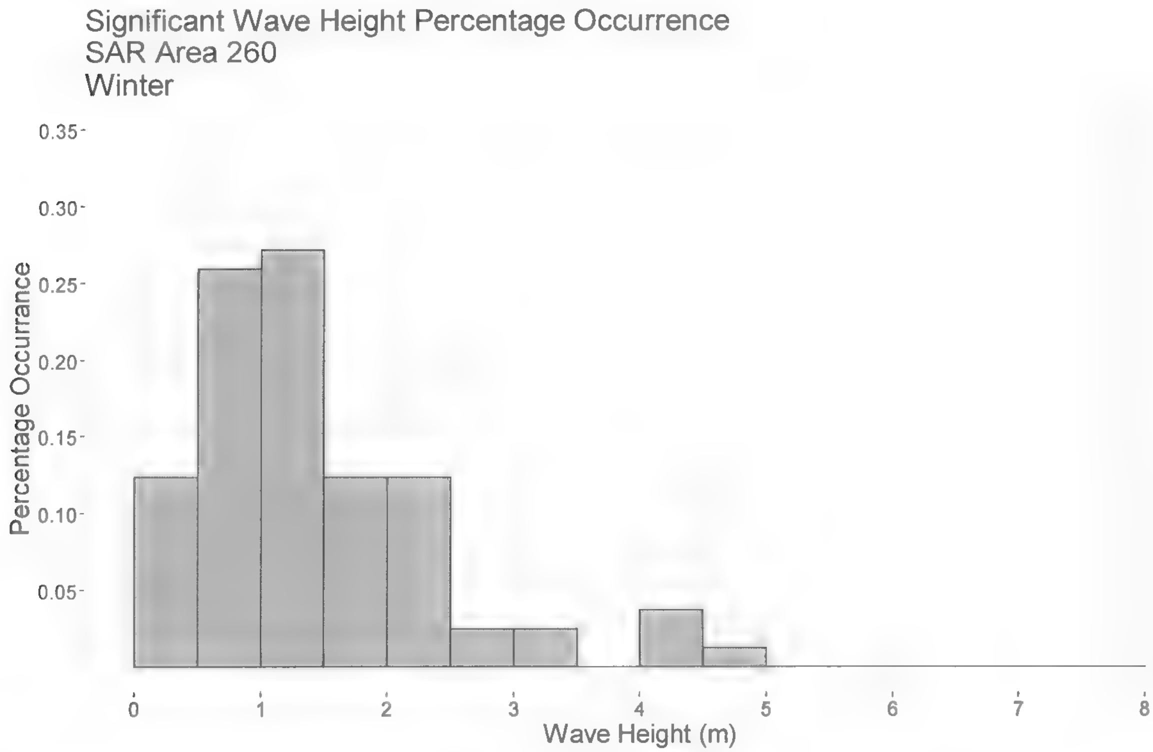

Figure 3.151 SAR Area 260 Winter Significant Wave Height Percentage Occurrence (ICOADS)

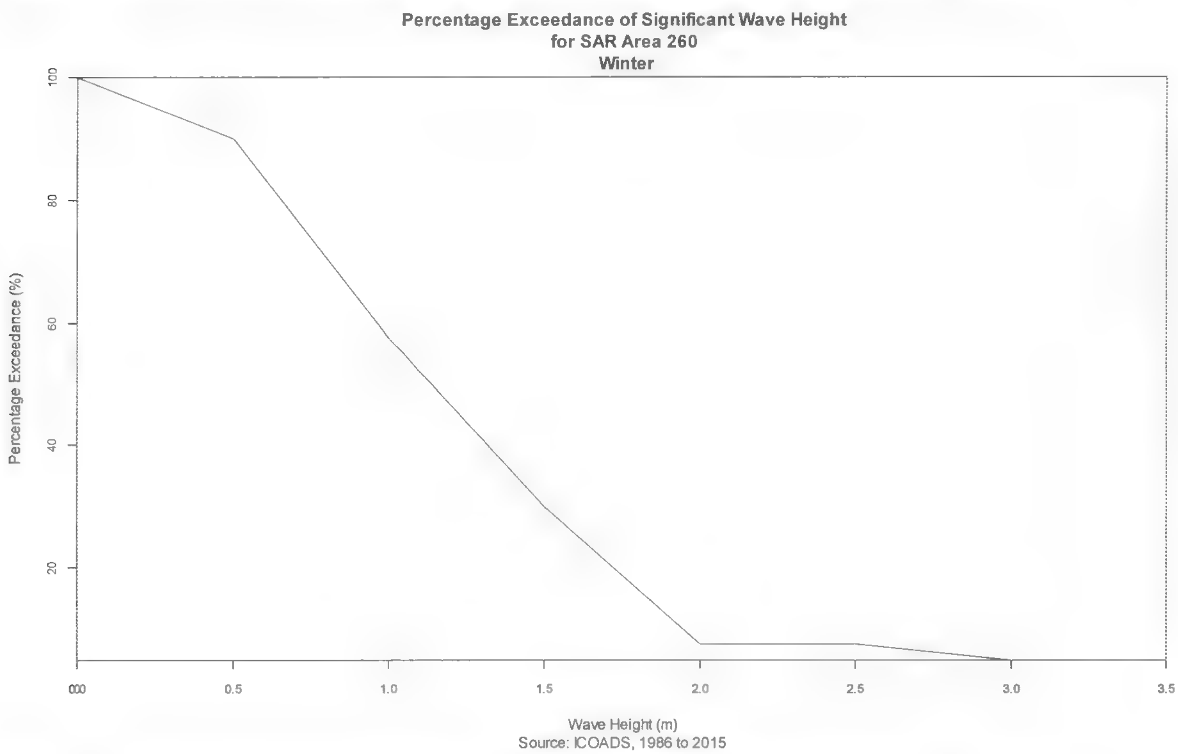

Figure 3.152 SAR Area 260 Winter Significant Wave Height Percentage Exceedance (ICOADS)

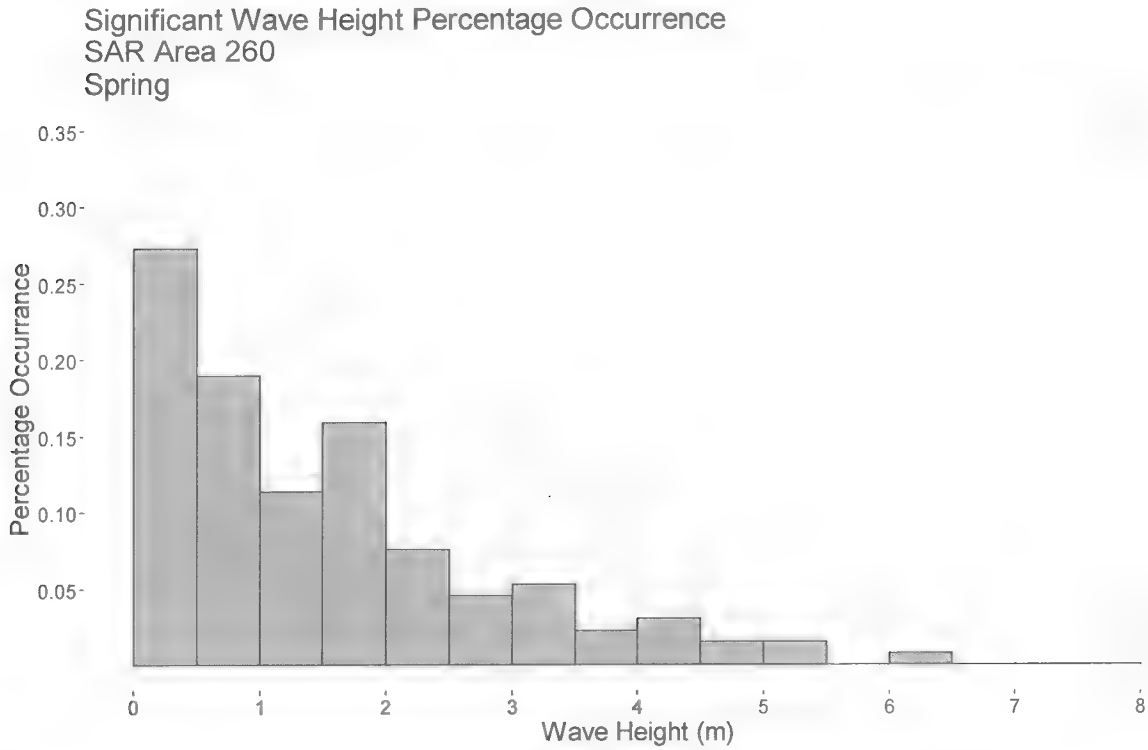

Figure 3.153 SAR Area 260 Spring Significant Wave Height Percentage Occurrence (ICOADS)

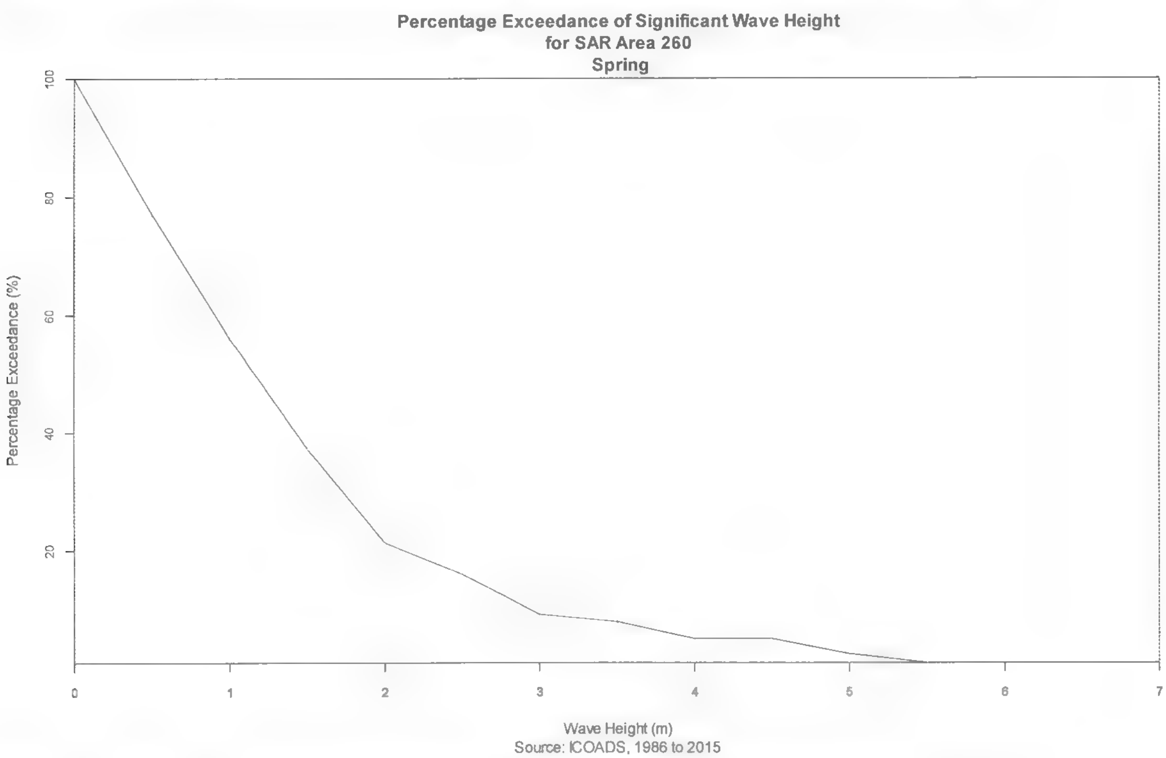

Figure 3.154 SAR Area 260 Spring Significant Wave Height Percentage Exceedance (ICOADS)

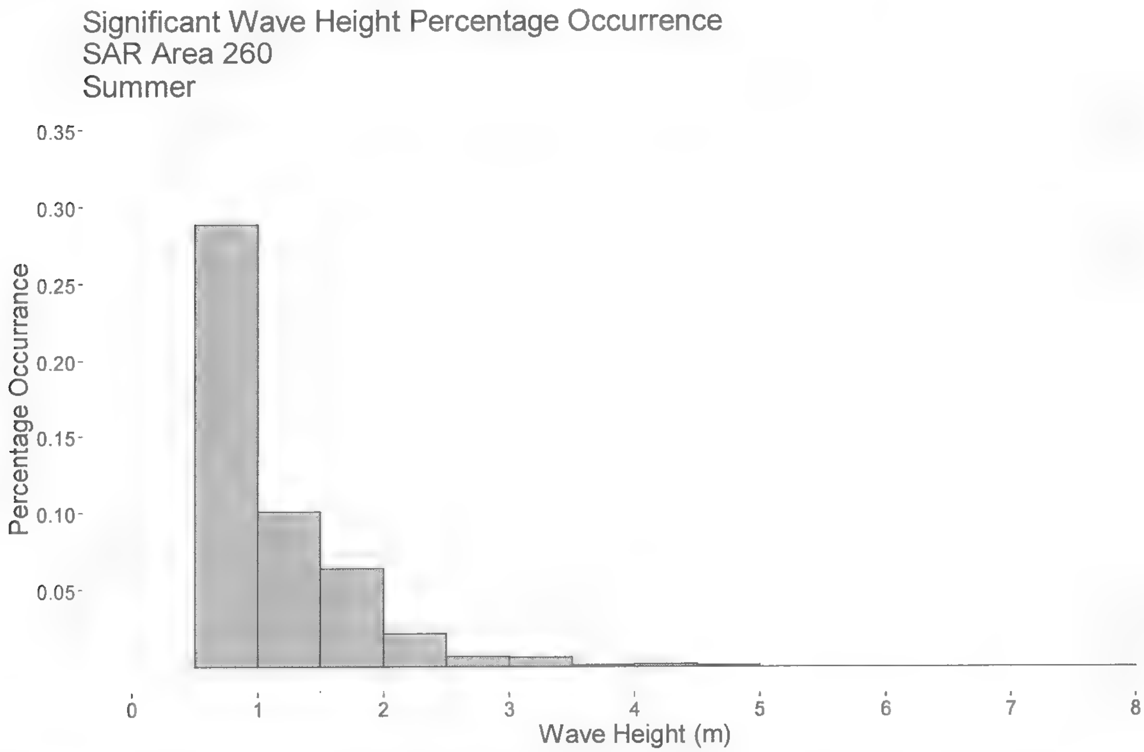

Figure 3.155 SAR Area 260 Summer Significant Wave Height Percentage Occurrence (ICOADS)

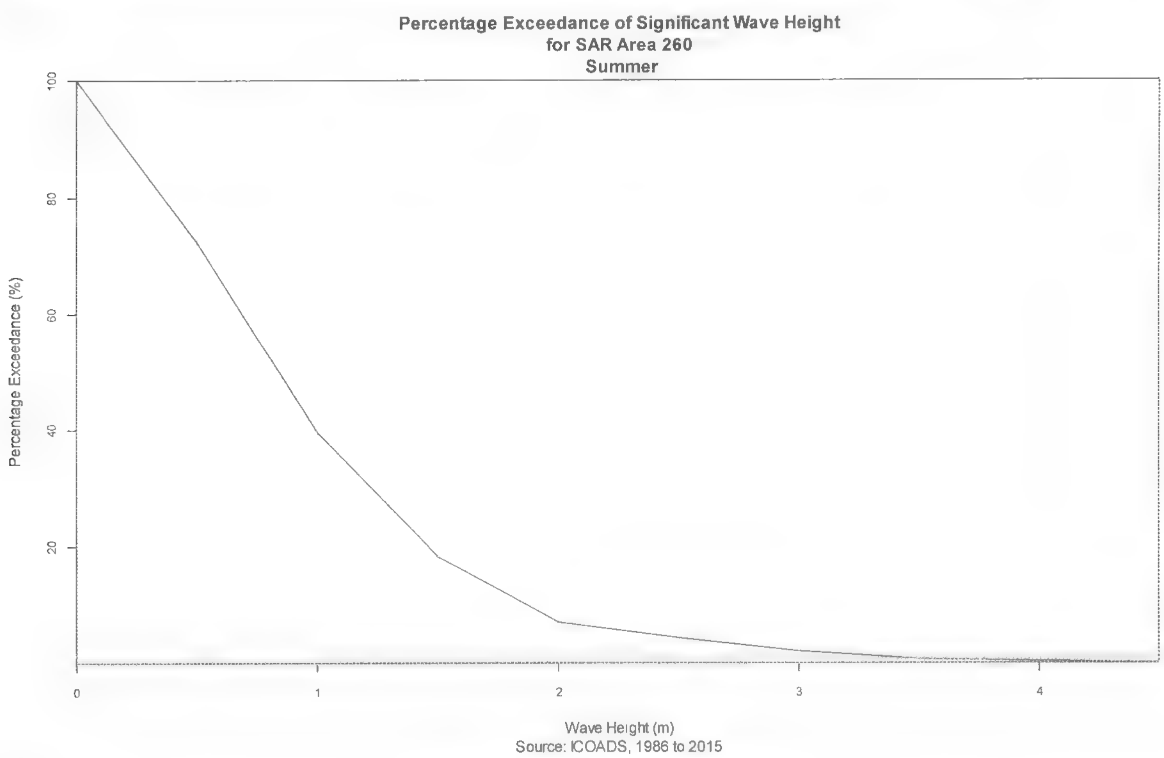

Figure 3.156 SAR Area 260 Summer Significant Wave Height Percentage Exceedance (ICOADS)

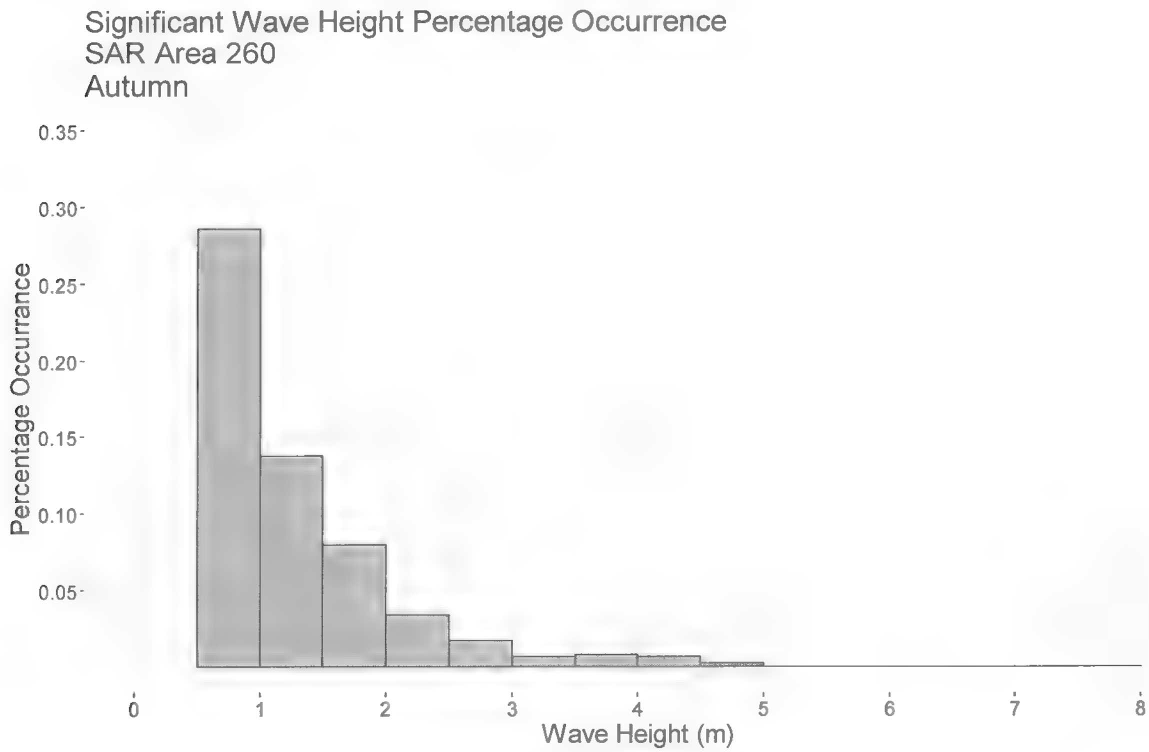

Figure 3.157 SAR Area 260 Autumn Significant Wave Height Percentage Occurrence (ICOADS)

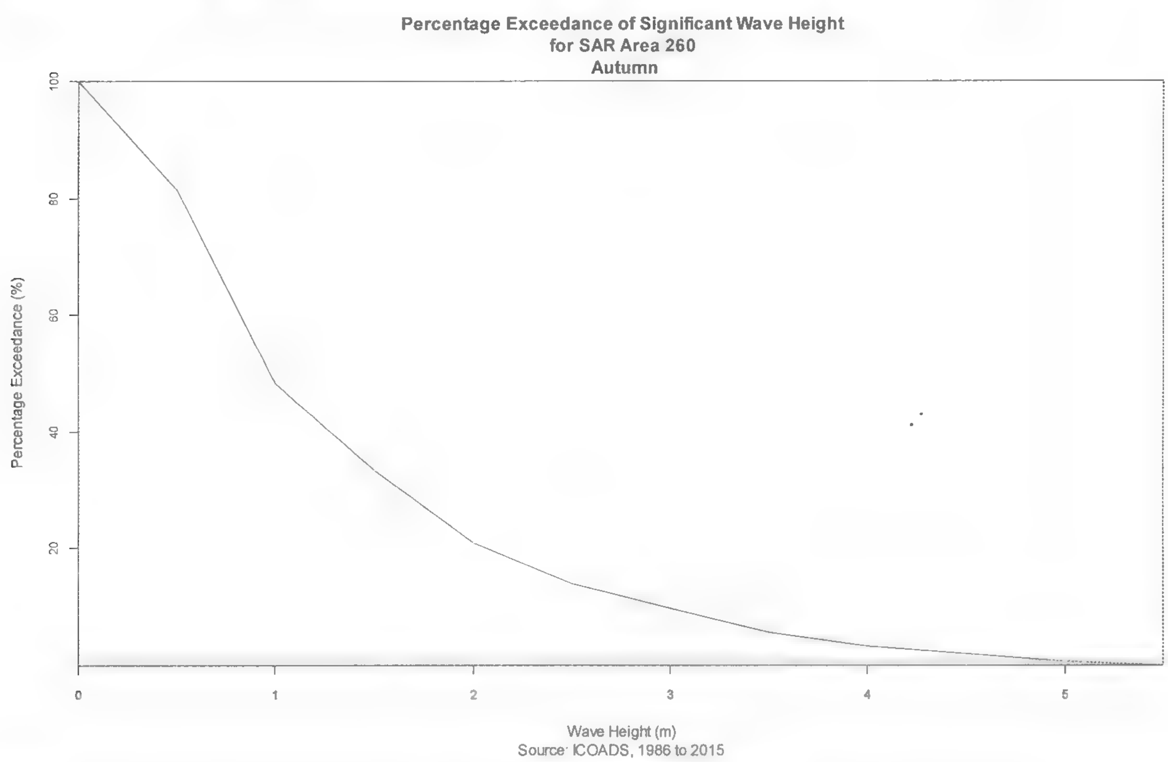

Figure 3.158 SAR Area 260 Autumn Significant Wave Height Percentage Exceedance (ICOADS)

Wind Wave Height

Seasonal mean, standard deviation, mean maximum and absolute maximum wind wave height statistics are provided in Table 3.14 for SAR Area 260.

Tables depicting the joint percentage frequency distribution of wind wave height and wind direction are provided in Table 3.77 and Table 3.78 for the summer and autumn seasons. There is insufficient directional data unavailable for the winter and spring seasons. The predominate wind wave height for summer and autumn is 1.0 – 2.0 metres from the east. When available, wave roses of the seasonal wind wave height and direction, the associated histogram of the wind wave height frequency and the wind wave height percentage exceedance are presented in Figure 3.159 through Figure 3.168.

The wave roses are in meteorological convention and depict the direction the waves are coming from.

Table 3.76 SAR Area 260 Seasonal Wind Wave Height Statistics from the ICOADS data set (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.2	0.8	1.8	5.0
Spring	1.2	0.9	1.8	5.0
Summer	0.8	0.5	2.3	4.0
Autumn	1.0	0.6	2.8	3.5

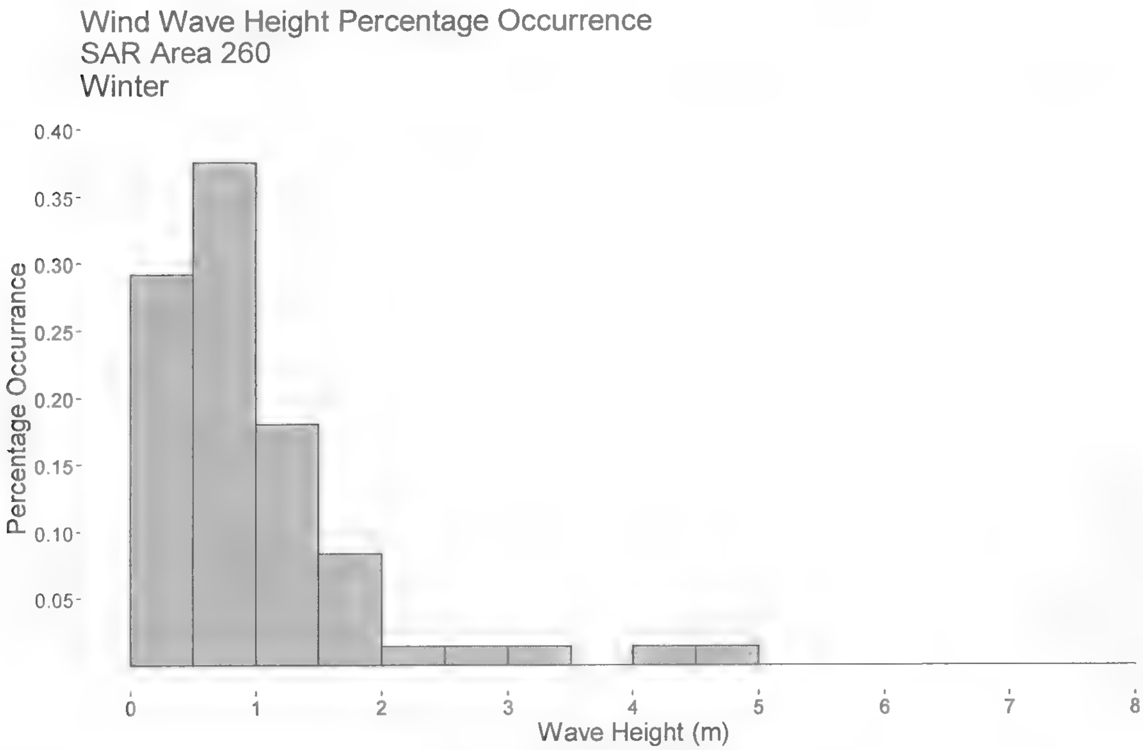

Figure 3.159 SAR Area 260 Winter Wind Wave Height Percentage Occurrence (ICOADS)

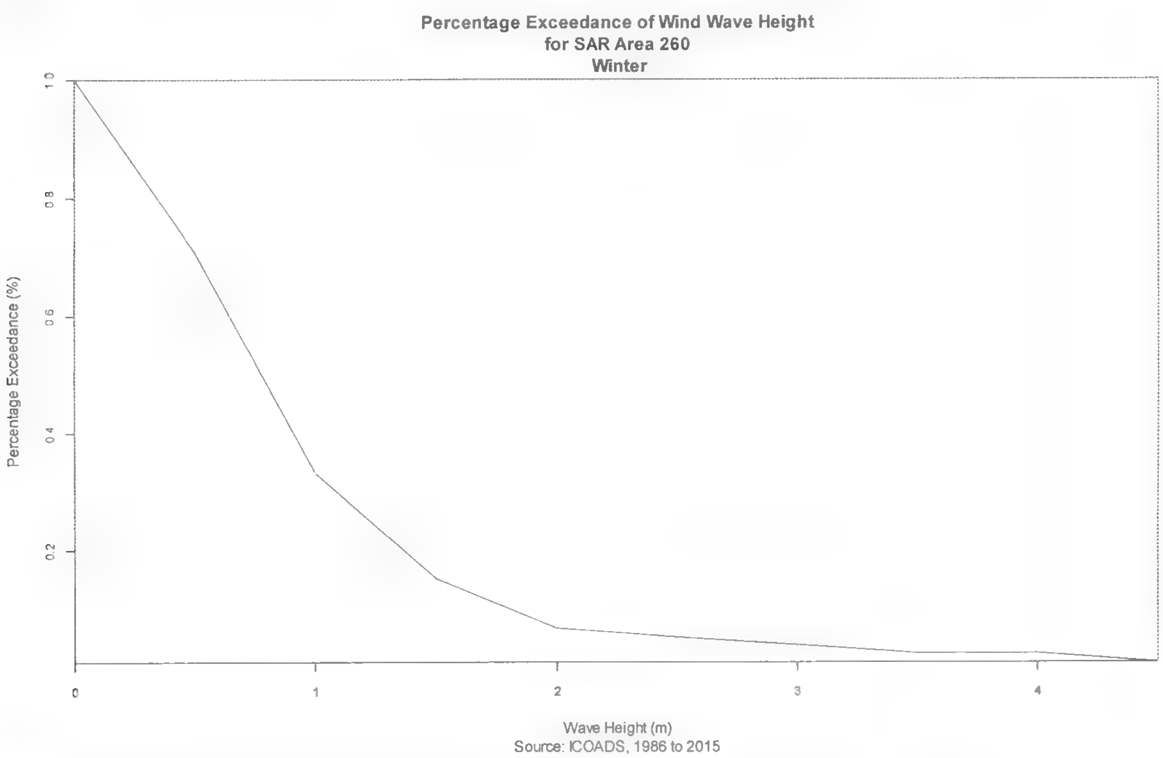

Figure 3.160 SAR Area 260 Winter Wind Wave Height Percentage Exceedance (ICOADS)

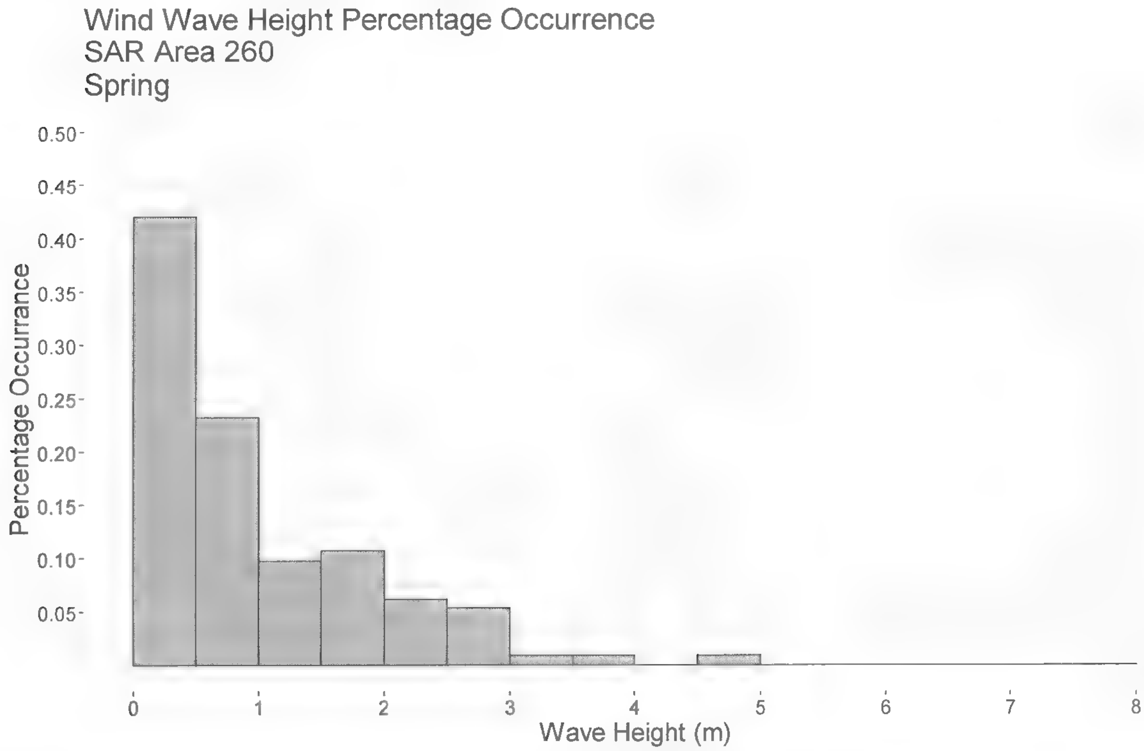

Figure 3.161 SAR Area 260 Spring Wind Wave Height Percentage Occurrence (ICOADS)

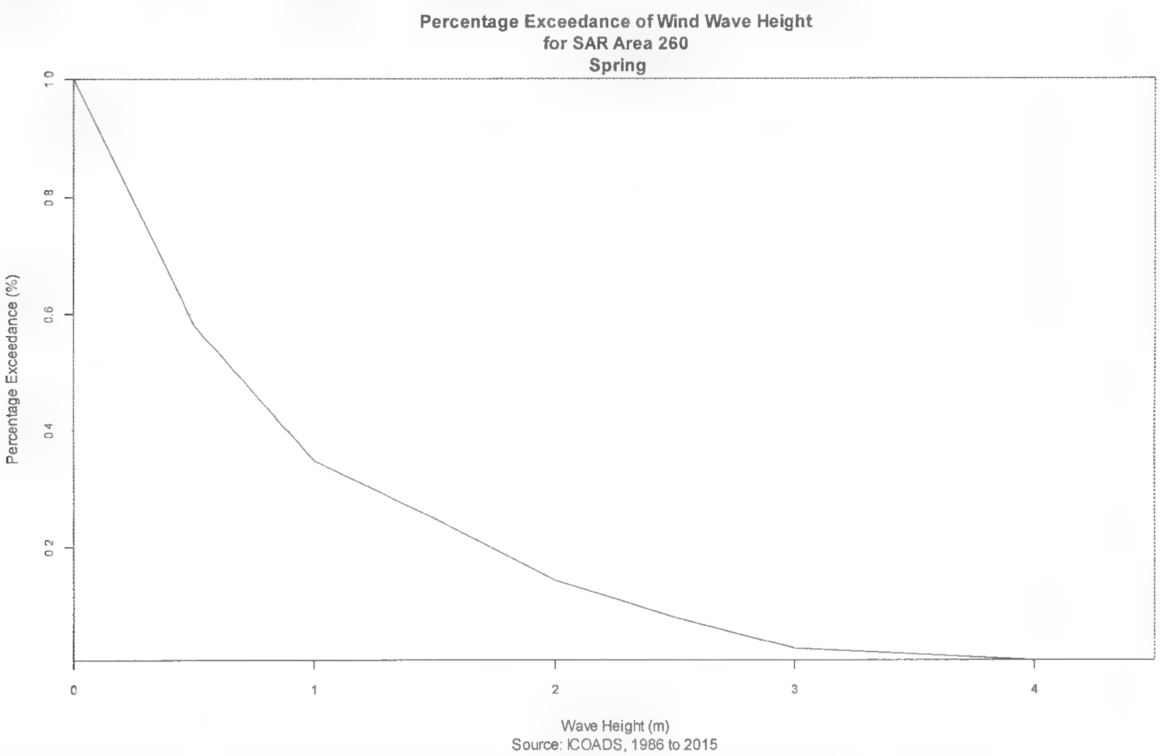

Figure 3.162 SAR Area 260 Spring Wind Wave Height Percentage Exceedance (ICOADS)

Table 3.77 SAR Area 260 Summer Joint Percentage Frequency Distribution of Wave Direction versus Wave Height (ICOADS)

Source: ICOADS — Total Samples: 2386

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	3.65	2.39	2.31	3.48	9.77	8.42	8.59	6.16	7.80	4.19	3.48	3.60	7.59	5.20	3.86	2.93	86.67
	1.0 - 2.0	0.46	0.21	0.29	0.21	0.96	0.88	1.13	1.09	0.96	0.46	0.63	0.38	1.38	1.26	0.21	0.38	11.86
	2.0 - 3.0	0.08	0.00	0.04	0.00	0.08	0.08	0.25	0.17	0.08	0.00	0.00	0.00	0.13	0.00	0.04	0.04	1.26
	3.0 - 4.0	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.21
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>– 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

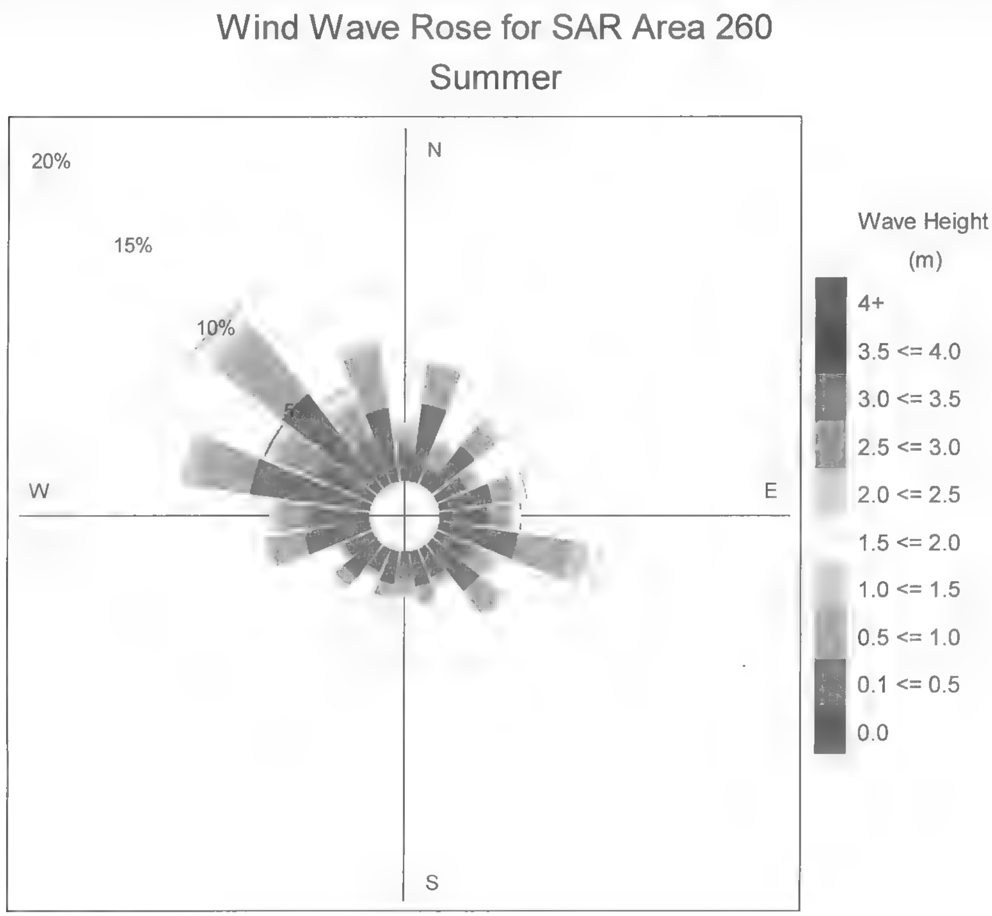

Figure 3.163 SAR Area 260 Summer Wave Rose Diagram (ICOADS)

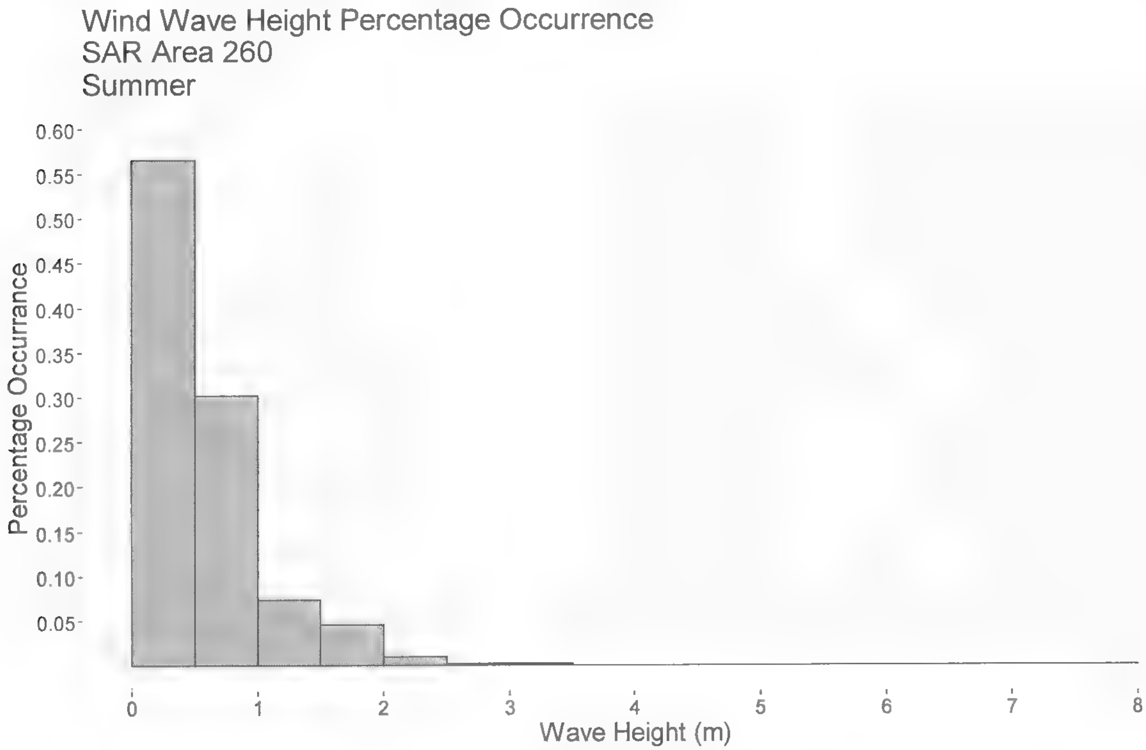

Figure 3.164 SAR Area 260 Summer Wind Wave Height Percentage Occurrence (ICOADS)

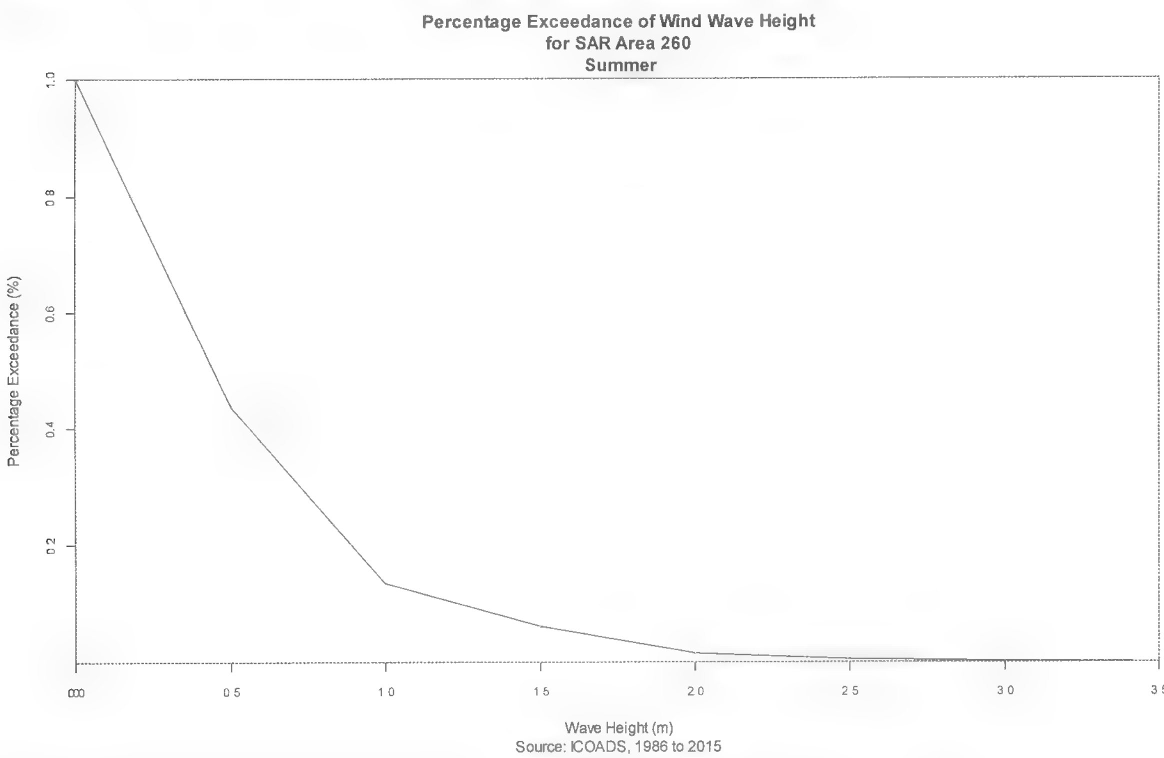

Figure 3.165 SAR Area 260 Summer Wind Wave Height Percentage Exceedance (ICOADS)

Table 3.78 SAR Area 260 Autumn Joint Percentage Frequency Distribution of Wind Direction versus Wind Wave Height (ICOADS)

Source: ICOADS | Total Samples: 3324

		Wave Direction (true / from)																
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Wave Height (m)	0.0 - 1.0	4.51	2.65	2.35	2.26	5.75	5.02	7.04	7.70	8.03	3.73	3.61	3.55	5.26	3.88	3.82	3.28	77.74
	1.0 - 2.0	1.02	0.60	0.48	0.27	1.17	1.38	1.84	1.62	1.14	0.69	0.87	1.41	1.53	1.11	0.75	0.72	18.65
	2.0 - 3.0	0.06	0.03	0.00	0.12	0.33	0.30	0.57	0.36	0.39	0.09	0.09	0.00	0.24	0.24	0.12	0.03	3.34
	3.0 - 4.0	0.00	0.03	0.00	0.00	0.00	0.00	0.06	0.03	0.00	0.03	0.03	0.00	0.00	0.00	0.03	0.00	0.27
	4.0 - 5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5.0 - 6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0 - 7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.0 - 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	>= 8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wind Wave Rose for SAR Area 260
Autumn

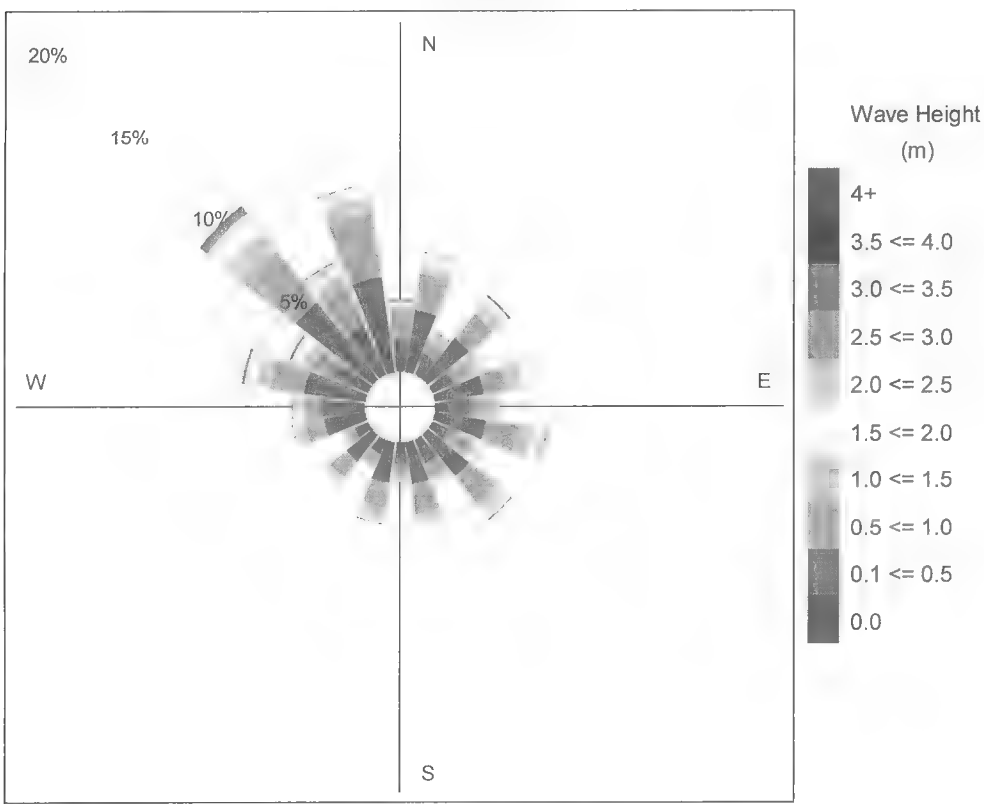

Figure 3.166 SAR Area 260 Autumn Wind Wave Rose Diagram (ICOADS)

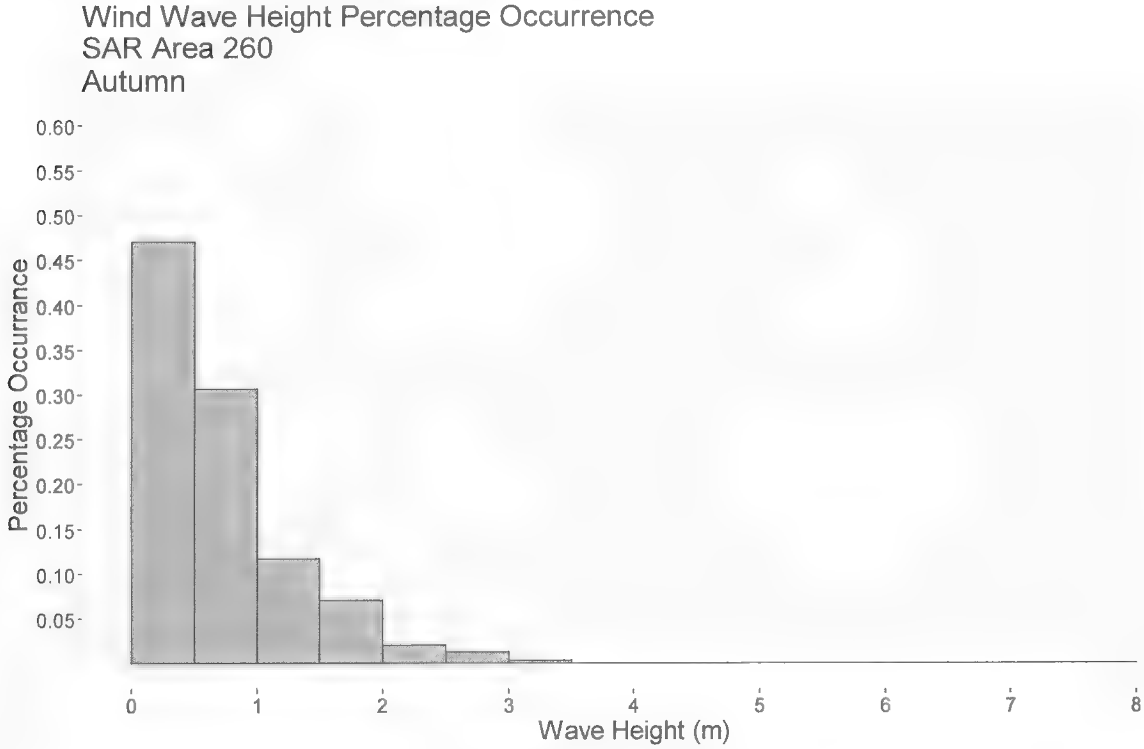

Figure 3.167 SAR Area 260 Autumn Wave Height Percentage Occurrence (ICOADS)

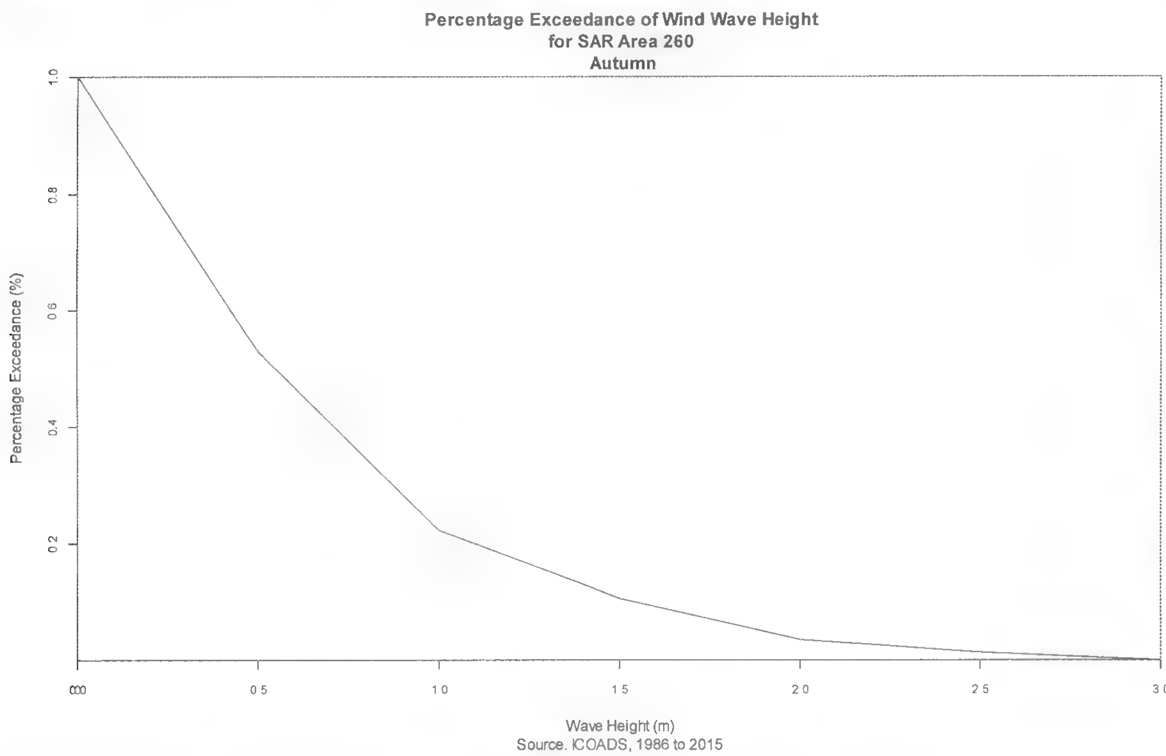

Figure 3.168 SAR Area 260 Autumn Wave Height Percentage Exceedance (ICOADS)

Swell Height

Seasonal mean, standard deviation, mean maximum and absolute maximum swell height statistics are provided in Table 3.79 for SAR Area 260.

There is insufficient directional data within the ICOADS wave data set to generate swell height wave roses or joint frequency of swell height and direction tables.

The associated histogram of the swell wave height frequency and the swell wave height percentage exceedance are presented in Figure 3.167 through Figure 3.176

Table 3.79 SAR Area 260 Seasonal Wave Height Statistics from the ICOADS data set (metres)

	Mean	Standard Deviation	Mean Seasonal Maximum	Absolute Maximum
Winter	1.5	0.8	1.8	4.0
Spring	1.7	1.3	3.0	7.5
Summer	1.2	0.7	2.5	5.5
Autumn	1.6	1.1	3.5	6.0

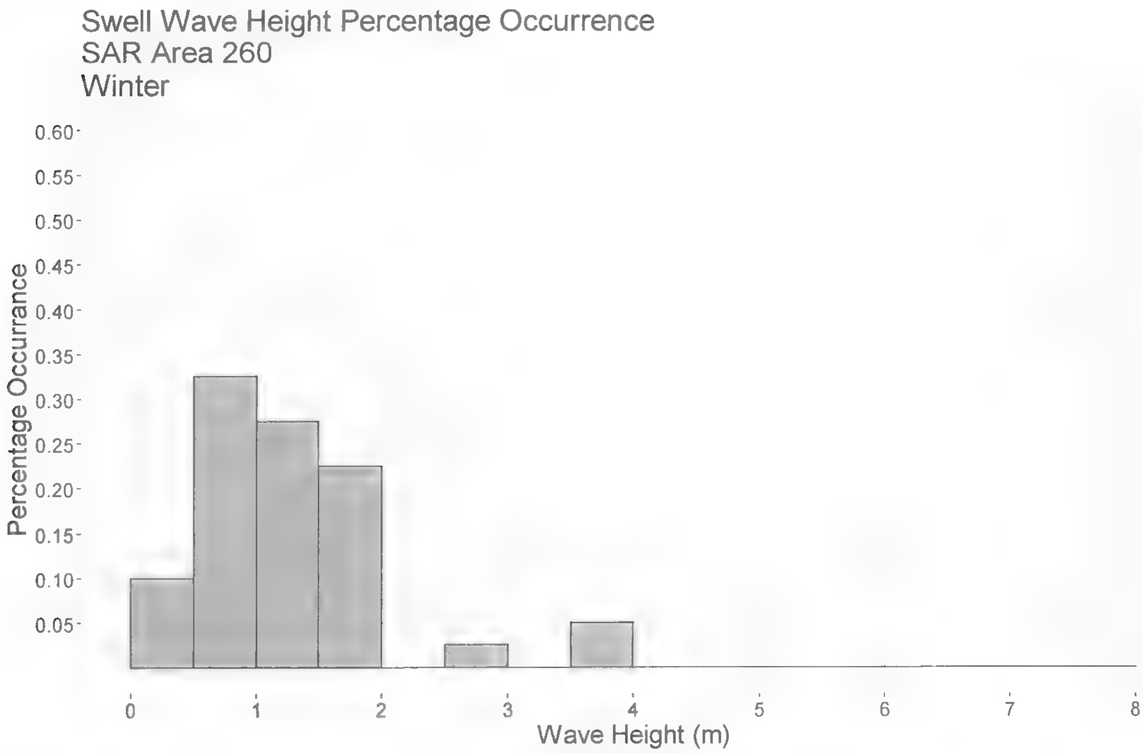

Figure 3.169 SAR Area 260 Winter Swell Height Percentage Occurrence (ICOADS)

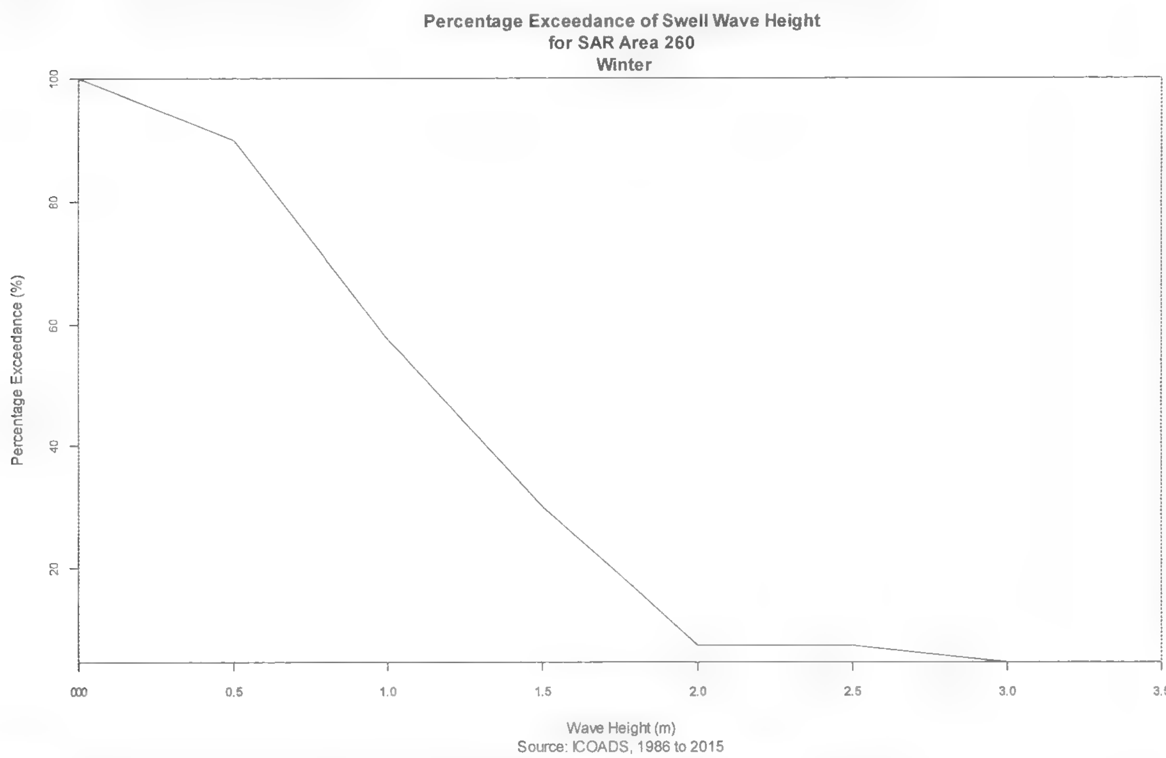

Figure 3.170 SAR Area 260 Winter Swell Height Percentage Exceedance (ICOADS)

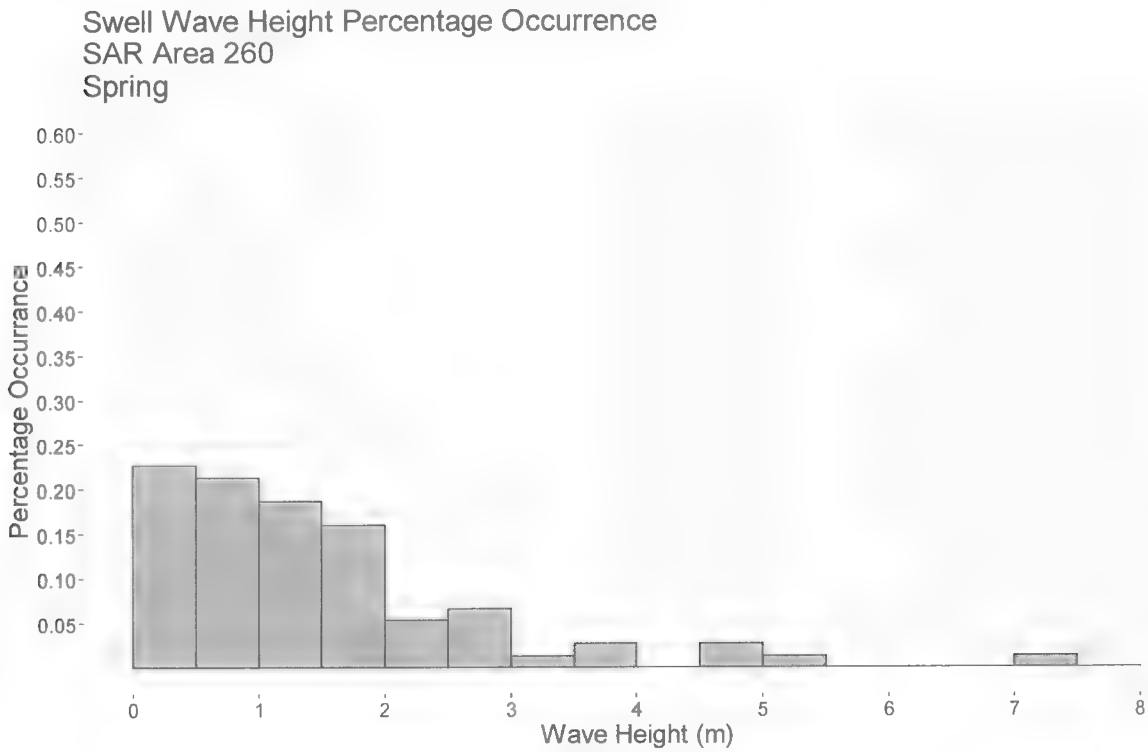

Figure 3.171 SAR Area 260 Spring Swell Height Percentage Occurrence (ICOADS)

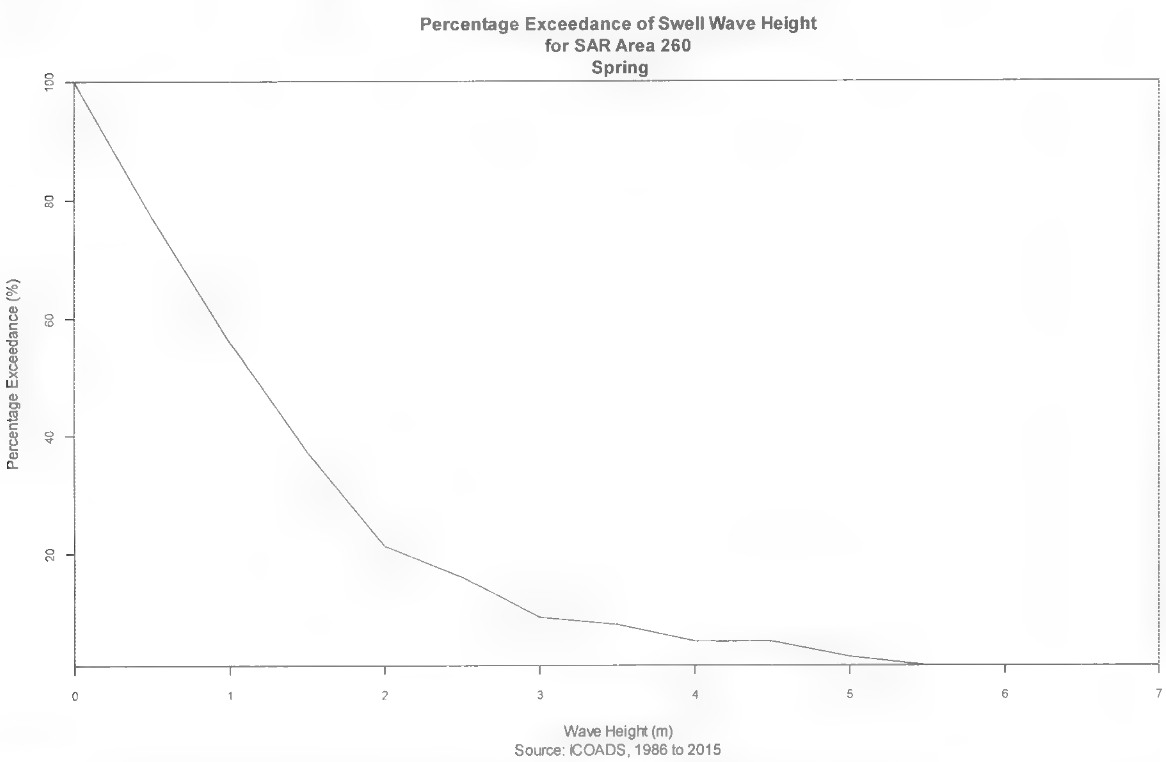

Figure 3.172 SAR Area 260 Spring Swell Height Percentage Exceedance (ICOADS)

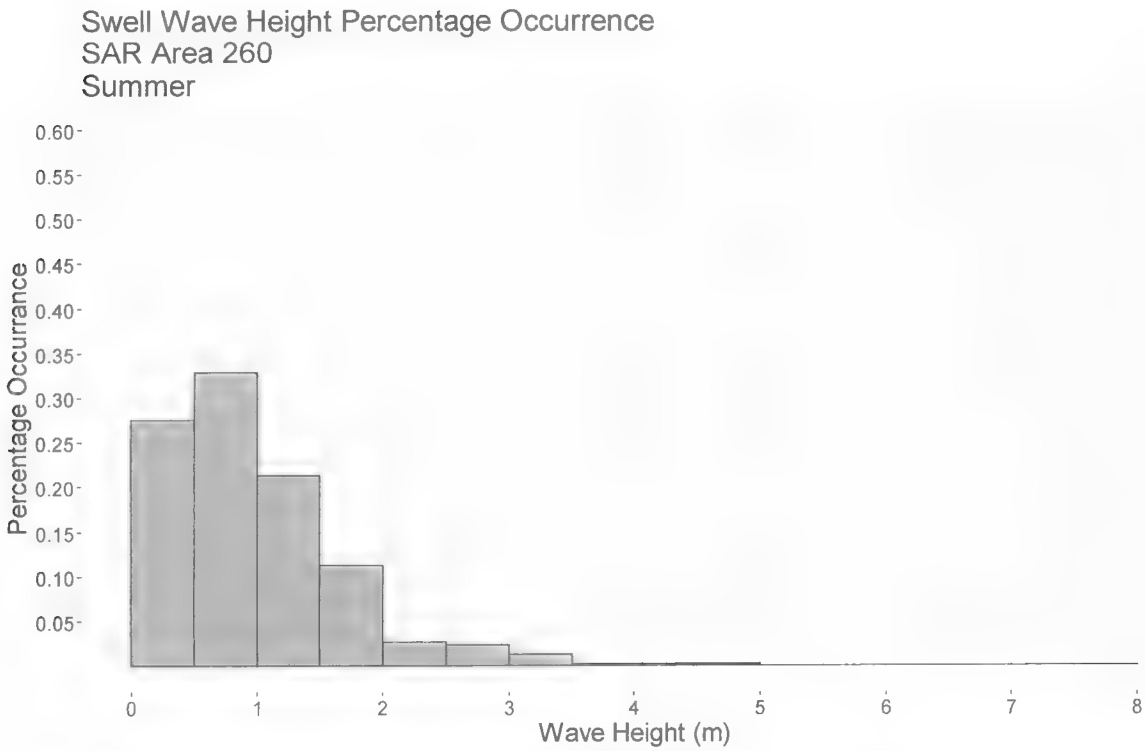

Figure 3.173 SAR Area 260 Summer Swell Height Percentage Occurrence (ICOADS)

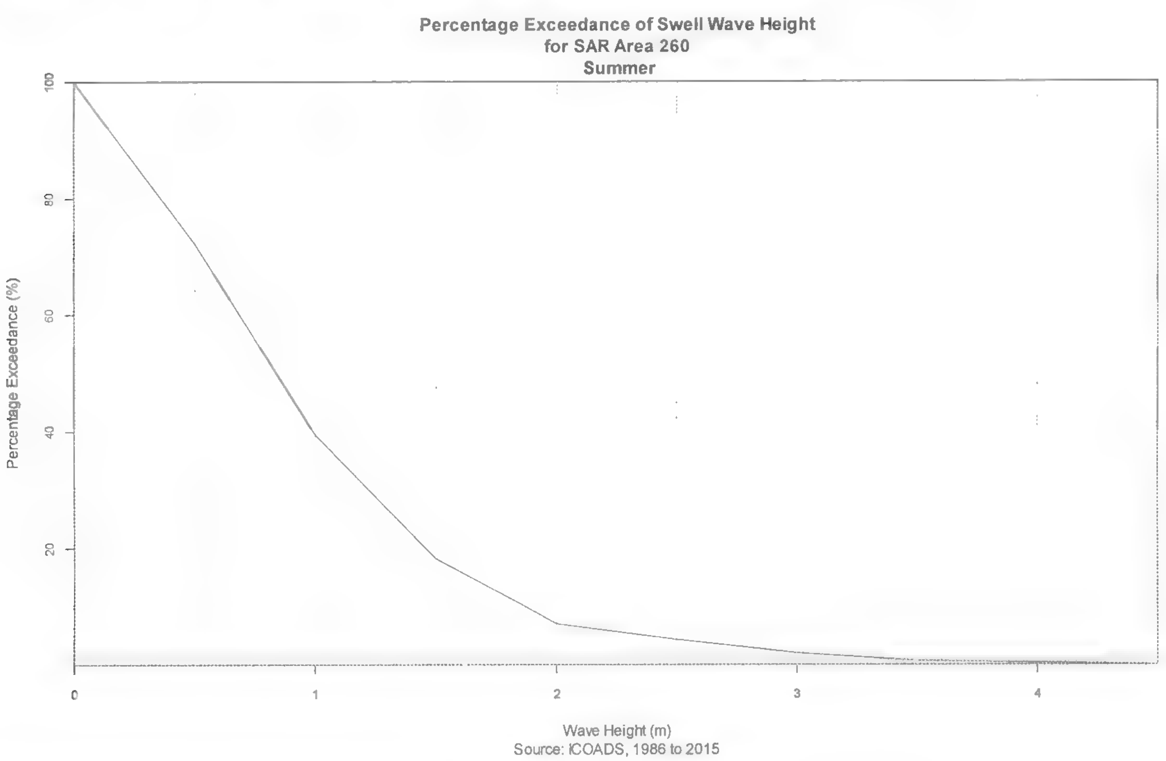

Figure 3.174 SAR Area 260 Summer Swell Height Percentage Exceedance (ICOADS)

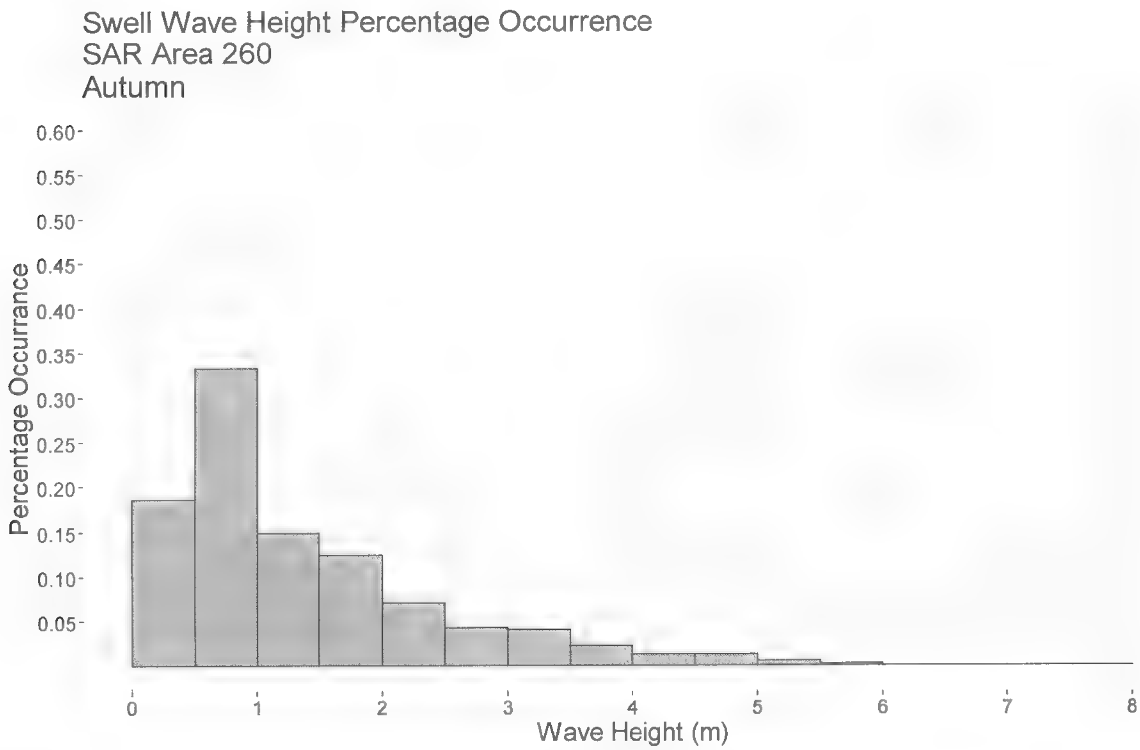

Figure 3.175 SAR Area 260 Autumn Swell Height Percentage Occurrence (ICOADS)

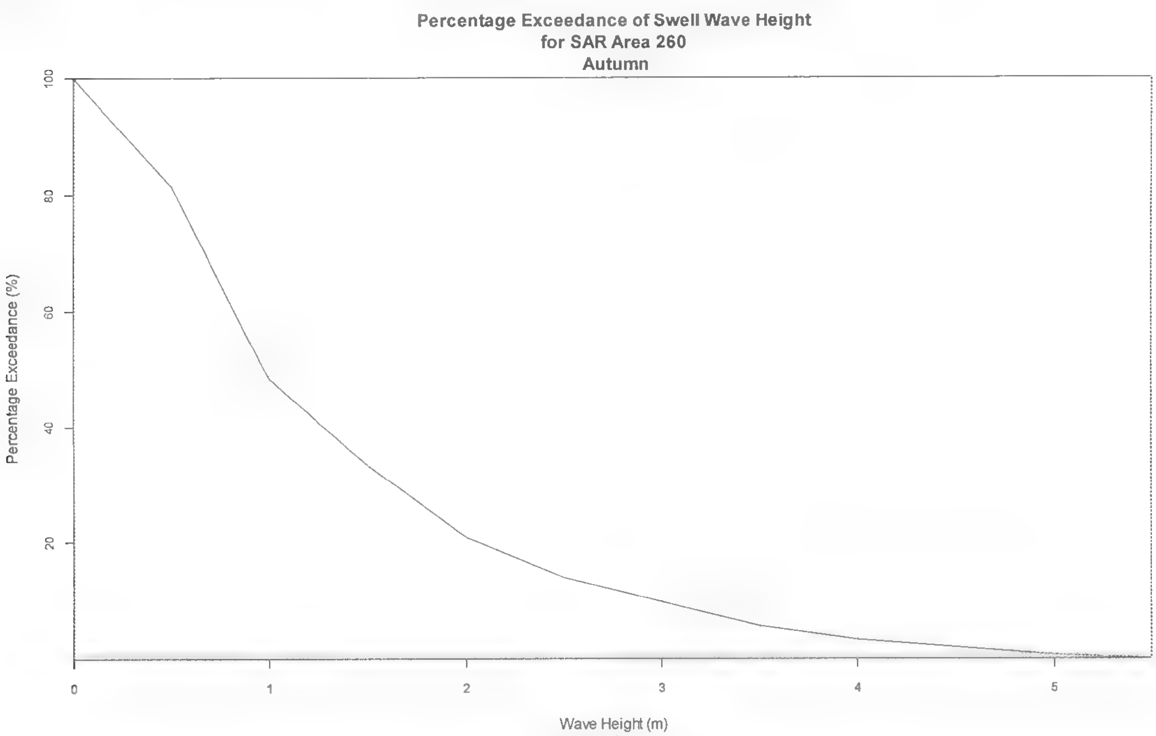

Figure 3.176 SAR Area 260 Autumn Swell Height Percentage Exceedance (ICOADS)

3.4.3 Air and Sea Surface Temperature

Air temperature statistics were obtained from the ISD data base while sea surface temperatures for the area were extracted from the ICOADS data set for SAR Area 260. Seasonal plots of air temperature versus sea surface temperature are presented in Figure 3.177. Air and sea surface temperature statistics are presented in Table 3.80. The atmosphere is coldest in January with a mean air temperature of -28.5°C, and warmest during July with a mean air temperature of 9.5°C.

Sea surface temperatures are warmest in July with a mean seasonal temperature of 4.5°C. Sea surface temperatures are unavailable from December through April due to the presence of sea ice.

The mean maximum and mean minimum temperature statistics were calculated by determining the seasons maximum and minimum for each year, then averaging over the number of years of data. These statistics are presented in Table 3.81.

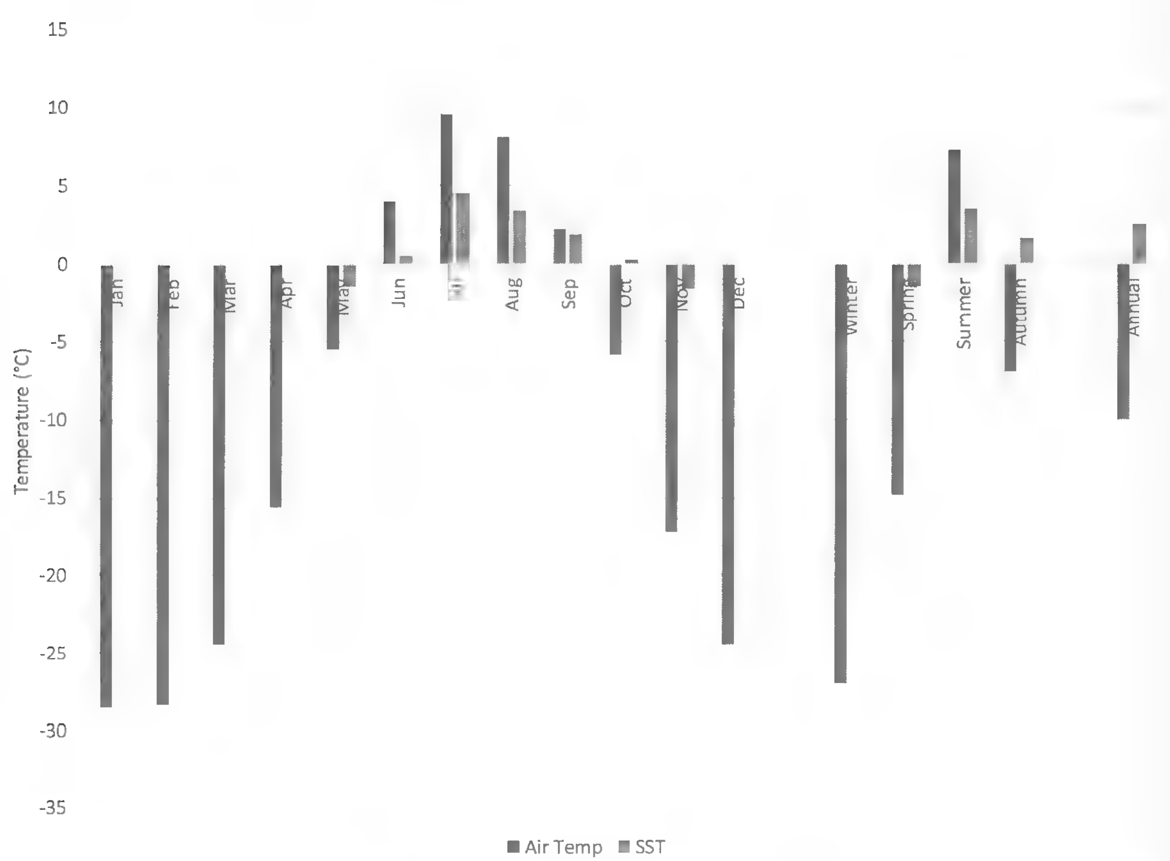

Figure 3.177 Monthly, Seasonal and Annual Mean Air and Sea Surface Temperature (°C) SAR Area 260 (ICOADS data set)

Table 3.80 Temperature (°C) Statistics for SAR Area 260

	Air Temperature (°C)				Sea Surface Temperature (°C)			
Month	Mean	Maximum	Minimum	Standard Deviation	Mean	Maximum	Minimum	Standard Deviation
January	-28.5	8.0	-53.0	8.5	NA	NA	NA	NA
February	-28.3	9.0	-54.0	8.8	NA	NA	NA	NA
March	-24.4	15.0	-50.0	9.8	NA	NA	NA	NA
April	-15.6	23.0	-43.0	9.2	NA	NA	NA	NA
May	-5.5	28.0	-32.0	7.4	-1.4	-0.2	-1.8	0.3
June	4.0	30.5	-16.0	5.9	0.5	4.1	-1.8	0.8
July	9.5	34.6	-3.1	5.8	4.5	11.3	-1.7	2.7
August	8.1	31.6	-11.0	5.3	3.4	13.3	-2.0	2.9
September	2.2	24.6	-14.1	5.0	1.9	11.4	-2.8	2.2
October	-5.8	22.0	-34.0	6.3	0.3	3.1	-2.3	1.4
November	-17.2	11.0	-44.0	8.5	-1.6	0.2	-2.8	0.7
December	-24.4	5.0	-48.0	8.5	NA	NA	NA	NA
Winter	-27.0	9.0	-54.0	8.8	NA	NA	NA	NA
Spring	-14.8	30.0	-50.0	11.8	-1.4	-0.2	-1.8	0.3
Summer	7.2	34.6	-16.0	6.1	3.5	13.3	-2.0	2.9
Autumn	-6.9	30.0	-44.0	10.4	1.6	11.1	-2.8	2.2
Annual	-10.0	34.6	-54.0	15.5	2.5	13.3	-2.8	2.7

Table 3.81 ICOADS Mean Maximum and Mean Minimum Temperature (°C) Statistics for SAR Area 260

	Air Temperature (°C)		Sea Surface Temperature (°C)	
Month	Mean Maximum	Mean Minimum	Mean Maximum	Minimum Standard Deviation
January	-1.7	-47.1	NA	NA
February	-0.1	-46.9	NA	NA
March	7.8	-45.0	NA	NA
April	16.4	-37.3	NA	NA
May	24.4	-25.6	-0.2	-1.8
June	28.1	-9.4	1.7	0.1
July	29.6	-1.9	7.6	-0.1
August	28.8	-2.5	9.9	-1.3
September	22.3	-10.6	7.0	-1.8
October	15.9	-26.1	1.7	-1.7
November	5.0	-36.6	-0.9	-1.6
December	-0.5	-43.3	NA	NA
Winter	2.4	-48.2	NA	NA
Spring	24.8	-45.0	-0.5	-1.3
Summer	30.7	-9.5	10.0	-1.4
Autumn	23.7	-36.7	7.0	-1.9
Annual	31.0	-48.3	10.0	-2.0

3.4.4 Sea Ice

Frequency of Presence

A weekly analysis of the Canadian Ice Service's Frequency of Presence of Sea Ice for the period of 1981 to 2010 was determined for SAR Area 260. These results are presented in Table 3.82 and Figure 3.178. Charts were unavailable for weeks which show no data.

These statistics show that the region is primarily affected by sea ice throughout the year. The Frequency of Presence is highest the week beginning April 02 (Figure 3.179).

Table 3.82 Frequency of Presence of Sea Ice within SAR Area 260 (1981 - 2010)

	Ice Free	1-15%	16-33%	34-50%	51-66%	67-84%	85-99%	100%
Jan-01	0.00	0.00	0.05	0.08	0.00	0.01	1.18	98.67
Jan-08								
Jan-15								
Jan-22								
Jan-29	0.00	0.00	0.05	0.08	0.00	0.01	1.15	98.71
Feb-05								
Feb-12								
Feb-19								
Feb-26	0.00	0.00	0.05	0.08	0.00	0.01	1.27	98.59
Mar-05								
Mar-12								
Mar-19								
Mar-26								
Apr-02	0.00	0.00	0.05	0.08	0.00	0.01	1.12	98.73
Apr-09								
Apr-16								
Apr-23								
Apr-30	0.00	0.00	0.05	0.08	0.00	0.04	4.99	94.83
May-07								
May-14	0.00	0.00	0.00	0.13	0.05	0.97	11.82	87.02
May-21								
May-28								
Jun-04	0.00	0.00	0.00	0.50	2.25	8.46	18.22	70.57
Jun-11	0.00	0.00	0.18	1.84	2.70	8.58	16.09	70.61
Jun-18	0.00	0.00	0.99	3.03	4.22	7.58	16.73	67.44
Jun-25	0.00	0.00	2.13	5.26	3.53	8.24	15.27	65.57
Jul-02	0.00	0.08	2.86	5.50	4.44	9.55	16.32	61.24
Jul-09	0.00	0.14	5.35	6.72	5.21	9.77	17.61	55.20
Jul-16	0.01	0.36	8.85	7.28	6.44	11.43	21.11	44.51
Jul-23	0.01	1.59	13.51	8.76	7.32	11.92	23.75	33.13
Jul-30	1.43	3.67	17.46	9.64	9.36	14.79	24.34	19.31
Aug-06	2.56	11.86	16.71	8.55	8.26	16.06	19.11	16.89
Aug-13	4.30	18.73	15.41	9.36	8.58	12.22	21.11	10.29
Aug-20	7.19	24.22	12.08	10.43	7.83	13.70	19.17	5.39
Aug-27	9.42	24.78	11.22	9.72	6.92	16.49	17.36	4.08
Sep-03	13.07	24.87	9.70	10.60	7.86	15.66	14.96	3.30
Sep-10	15.74	21.89	11.18	10.44	7.84	14.51	16.48	1.92

Sep-17	21.20	14.93	9.48	12.80	6.92	12.14	17.32	5.20
Sep-24	18.00	15.19	7.57	12.75	9.87	11.93	16.93	7.77
Oct-01	15.13	15.29	6.84	4.52	9.70	16.64	23.87	8.01
Oct-08	5.91	11.83	11.18	5.03	3.81	19.96	25.13	17.15
Oct-15	0.32	8.17	9.99	5.55	7.19	15.10	26.22	27.47
Oct-22	0.00	2.65	5.25	7.45	5.81	9.17	30.80	38.86
Oct-29	0.00	0.00	1.74	3.70	3.24	11.95	31.49	47.87
Nov-05	0.00	0.00	0.05	0.08	0.78	6.04	18.36	74.68
Nov-12	0.00	0.00	0.05	0.08	0.01	0.72	13.06	86.09
Nov-19	0.00	0.00	0.05	0.08	0.01	0.03	2.83	97.00
Nov-26	0.00	0.00	0.05	0.08	0.00	0.01	2.31	97.54
Dec-04	0.00	0.00	0.05	0.08	0.01	0.51	0.94	98.42

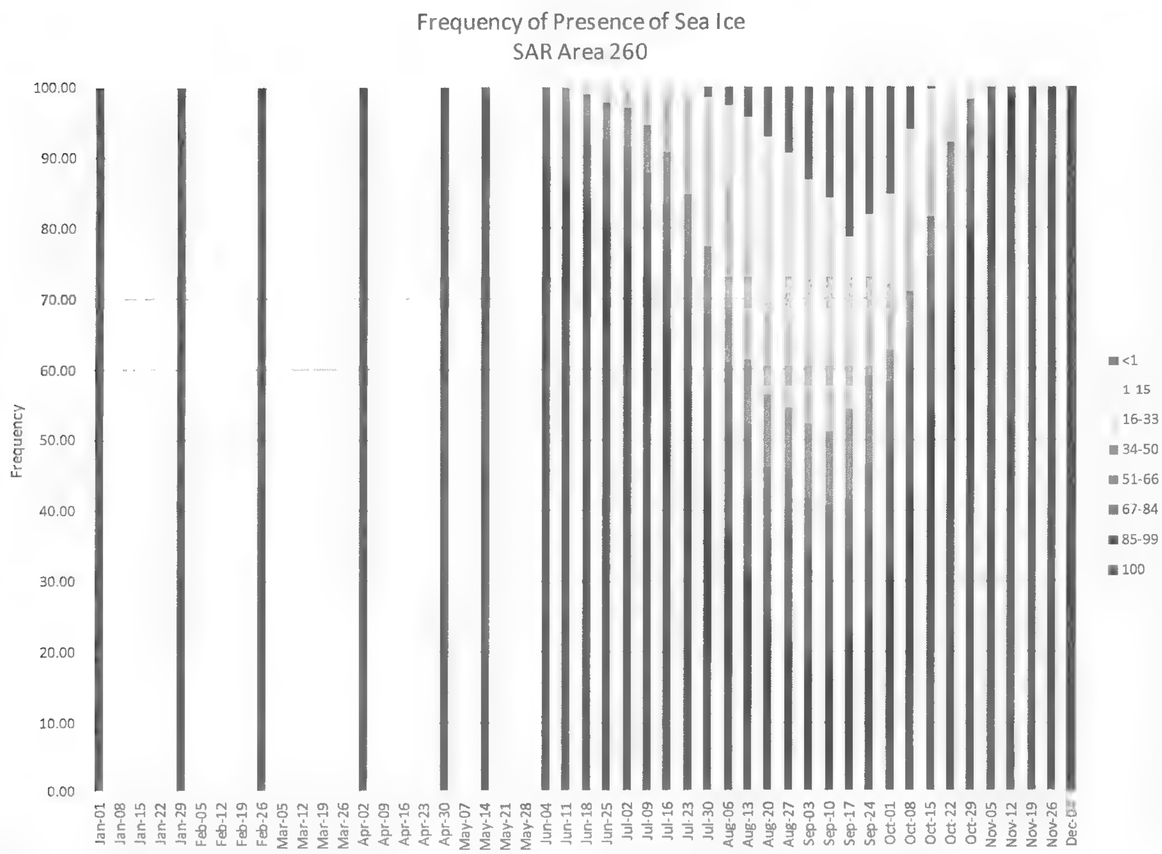

Figure 3.178 Plot of Frequency of Presence of Sea Ice within SAR Area 260 (1981 - 2010)

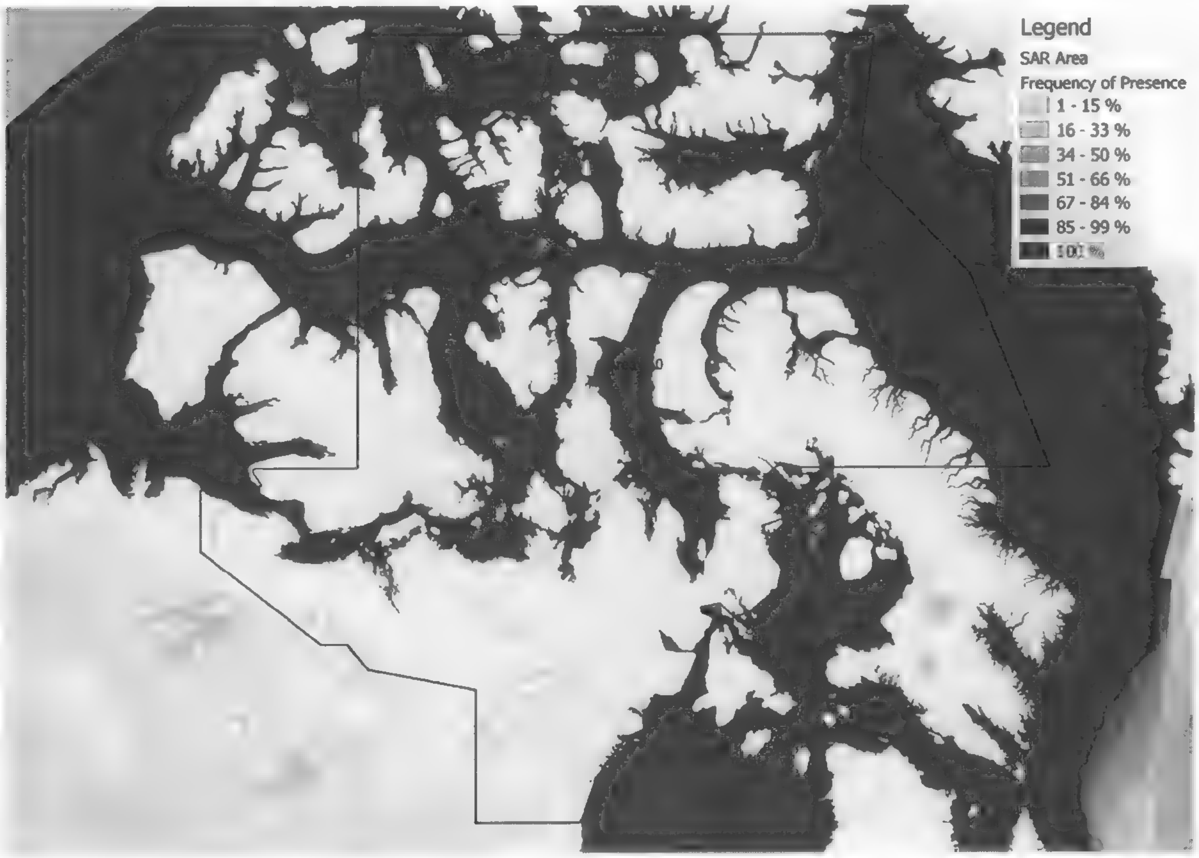

Figure 3.179 Frequency of Presence of Sea Ice for the week of February 26 within SAR Area 260 (1981 - 2010)

Median Concentration of Sea Ice

The region has sea ice concentrations of 9 tenths or greater from the weeks beginning November 12 through April 30. The week beginning June 11 has the highest coverage of 10 tenths sea ice concentration (Table 3.83 and Figure 3.180). Figure 3.181 depicts the median concentration of sea ice for the week of June 11.

Table 3.83 Median Concentration of Sea Ice within SAR Area 260 (1981 - 2010)

	Ice Free	1/10 - 3/10	4/10 - 6/10	7/10 - 8/10	9/10 - 9+/10	10/10	Total Ice
Jan-01	0.00	0.00	0.00	0.00	36.92	63.08	100.00
Jan-08							
Jan-15							
Jan-22							
Jan-29	0.00	0.00	0.00	0.00	34.43	65.57	100.00
Feb-05							
Feb-12							
Feb-19							
Feb-26	0.00	0.00	0.00	0.00	32.28	67.72	100.00
Mar-05							
Mar-12							
Mar-19							
Mar-26							
Apr-02	0.00	0.00	0.00	0.00	30.42	69.58	100.00
Apr-09							
Apr-16							
Apr-23							
Apr-30	0.00	0.00	0.00	0.00	29.27	70.73	100.00
May-07							
May-14	0.00	0.00	0.00	0.10	29.16	70.74	100.00
May-21							
May-28							
Jun-04	0.00	0.15	2.35	0.95	26.44	70.11	100.00
Jun-11	0.00	0.55	2.70	1.99	22.74	72.03	100.00
Jun-18	0.00	1.55	3.50	1.28	22.83	70.84	100.00
Jun-25	0.00	1.95	3.04	3.60	20.71	70.70	100.00
Jul-02	0.00	5.87	3.95	3.96	18.91	67.31	100.00
Jul-09	0.00	6.27	3.96	7.09	19.01	63.67	100.00
Jul-16	0.01	12.01	7.00	4.25	20.75	55.98	99.99
Jul-23	0.01	14.06	9.74	7.12	29.38	39.69	99.99
Jul-30	1.39	17.88	9.79	6.16	42.13	22.66	98.61
Aug-06	2.56	18.03	15.20	7.79	48.06	8.37	97.44
Aug-13	4.37	20.76	17.28	10.47	43.19	3.93	95.63
Aug-20	7.20	27.10	15.11	6.79	42.30	1.49	92.80
Aug-27	10.07	27.18	19.39	9.48	33.62	0.26	89.93
Sep-03	13.14	29.07	17.29	9.28	31.21	0.00	86.86

Sep-10	15.75	29.41	14.28	8.96	31.60	0.00	84.25
Sep-17	21.25	16.48	14.06	10.07	38.14	0.01	78.75
Sep-24	18.00	15.70	9.61	9.26	47.43	0.00	82.00
Oct-01	15.23	3.03	10.13	9.23	62.28	0.09	84.77
Oct-08	5.91	3.12	4.04	8.47	76.95	1.51	94.09
Oct-15	0.32	0.45	4.59	2.63	89.03	2.98	99.68
Oct-22	0.00	0.00	0.74	0.64	90.70	7.92	100.00
Oct-29	0.00	0.00	0.33	0.58	84.55	14.54	100.00
Nov-05	0.00	0.00	0.00	0.04	76.92	23.04	100.00
Nov-12	0.00	0.00	0.00	0.00	71.05	28.95	100.00
Nov-19	0.00	0.00	0.00	0.00	62.23	37.77	100.00
Nov-26	0.00	0.00	0.00	0.00	58.14	41.86	100.00
Dec-04	0.00	0.00	0.00	0.00	53.97	46.03	100.00

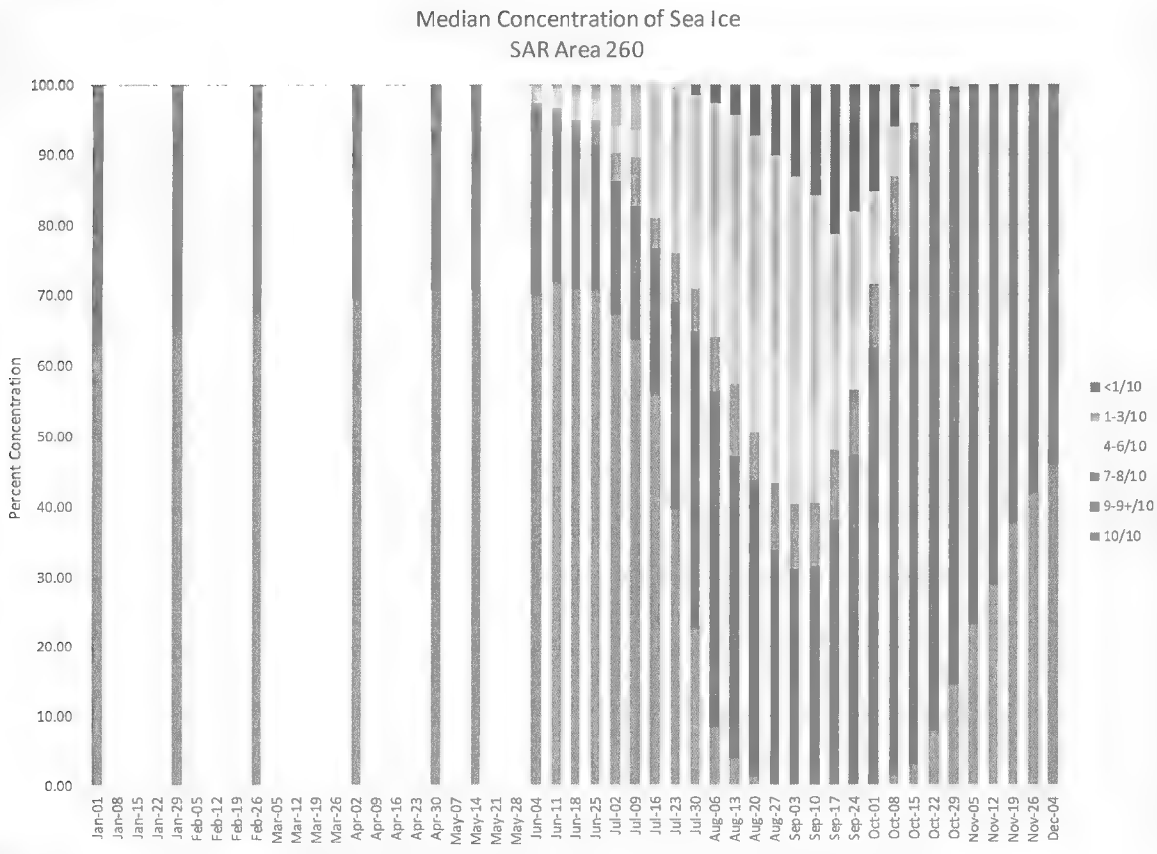

Figure 3.180 Plot of Median Concentration of Sea Ice within SAR Area 260 (1981 - 2010)

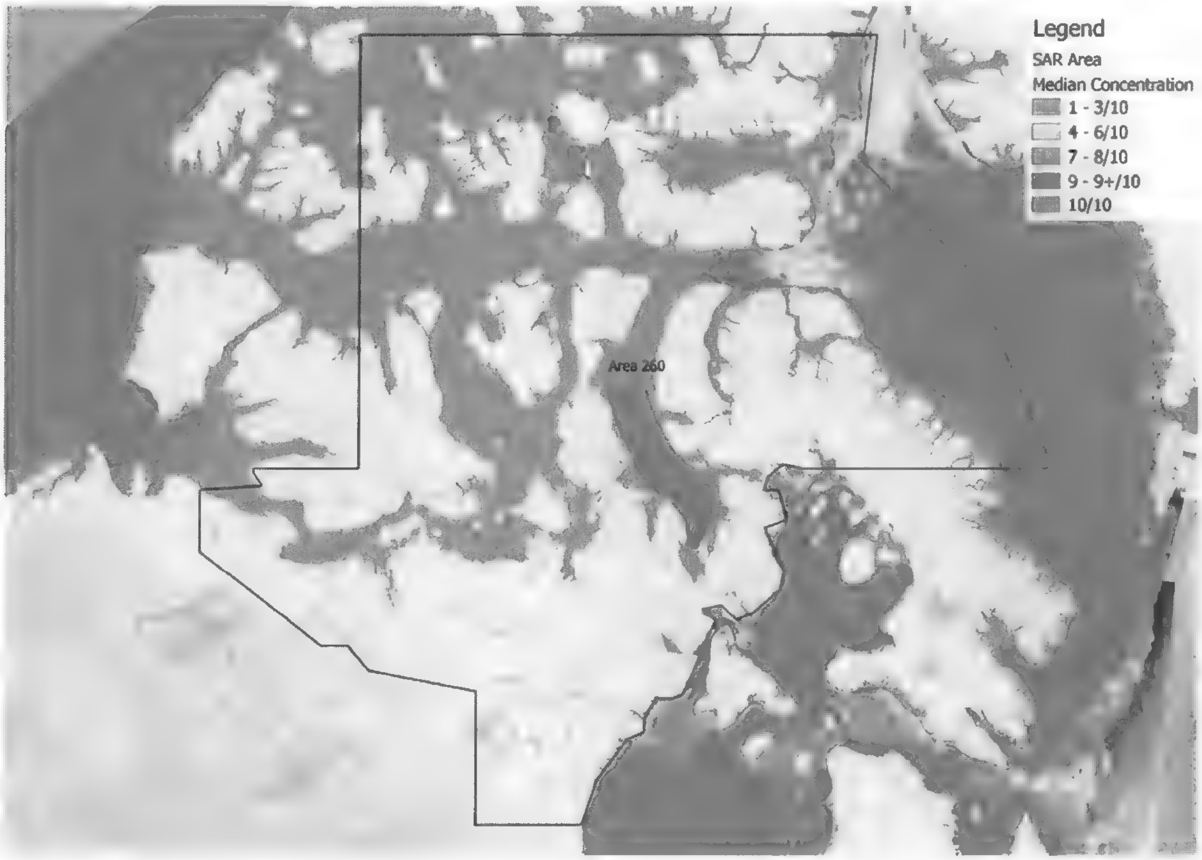

Figure 3.181 Median Concentration of Sea Ice for the week of February 26 within SAR Area 260 (1981 - 2010)

Predominant Ice Type

The presence of thick sea ice occurs within SAR Area 260 throughout the year. The week of January 29 has the highest concentration of thick sea ice with 100% of the region covered in at least 15 cm thick and a concentration of 7 tenths or greater. During this period, charts of the "Median Concentration of Ice when Ice is Present" indicate that 100% of the sea ice present is greater than 9 tenths. A chart depicting the predominant ice type when ice is present for the week of February 26 is provided below in Figure 3.57.

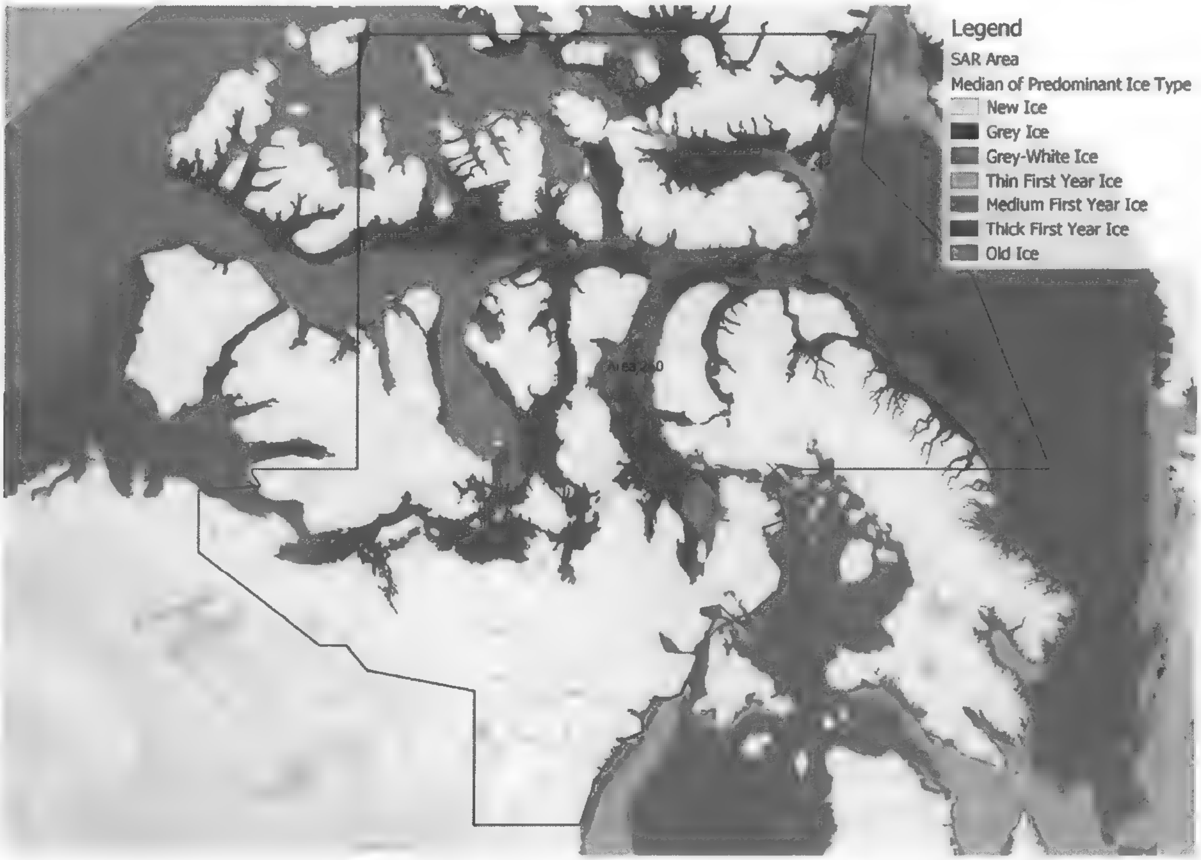

Figure 3.182 Median of Predominant Ice Type when Ice is Present (January 29)

3.4.5 *Summary Climate Statistics*

Table 3.84 Area 010 Summary Climate Statistics

Parameter	Description	Winter	Spring	Summer	Autumn
Wind Direction	Prevailing Wind Direction	WNW	NW	N	NW
Wind Speed	Mean Seasonal (knots)	10.4	9.9	9.1	10.7
	Mean Seasonal Maximum (kts)	40.5	36 7	32 1	39.0
Significant Wave Height	Percentage Frequency > 2.0 m	7.5	21 3	7.0	20.9
Air Temperature	Mean Temperature (°C)	-27.0	-14.8	7.2	-6.9
Sea Surface Temperature	Mean Seasonal Maximum Temperature (°C)	NA	-0.5	10 0	7.0
	Mean Seasonal Minimum Temperature (°C)	NA	-1 3	-1.4	-1.9
Seasonal Sea Ice Coverage	Mean Days per Season of Ice with concentration > 7/10 and thickness > 15cm	90	92	92	91
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	100	100	95.1	91.9
Seasonal Sea Ice Type	New Ice				Y
	Grey Ice	Y	Y		Y
	Grey-White Ice	Y	Y		Y
	Thin First Year Ice	Y	Y	Y	Y
	Medium First Year Ice	Y	Y	Y	Y
	Thick First Year Ice	Y	Y	Y	Y
	Old Ice	Y	Y	Y	Y

		D	J	F	M	A	M	J	J	A	S	O	N
Monthly Lake Ice Coverage	Mean Days per Month of Ice with concentration > 7/10 and thickness > 15cm	31	31	28		30	31	30	31	31	30	31	30
	Mean Areal Coverage of ice with concentration > 7/10 and thickness > 15cm	100	100	100		100	100	99.1	96.0	89.9	87.7	89.4	99.3
Monthly Lake Ice Type	New Ice										Y	Y	
	Grey Ice	Y		Y			Y				Y	Y	Y
	Grey-White Ice	Y	Y	Y		Y	Y				Y	Y	Y
	Thin First Year Ice	Y	Y	Y		Y	Y	Y				Y	Y
	Medium First Year Ice	Y	Y	Y		Y	Y	Y					Y
	Thick First Year Ice		Y	Y		Y	Y	Y	Y	Y	Y		
	Old Ice	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y

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DFO-MPO

Community Engagement and Exercise Team Reports

2018

Brianna Queneville & Breagh Harrie

9/6/2018

Overview

During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill. On the days of Thursday, July 26th, 2018 through Sunday, July 29th, 2018, the Arctic Exercising and Community Engagement Team travelled to the Hamlet of Arviat. The team consisted of Brianna Quenneville and Levi Eegeesiak. A meeting with the Senior Administrative Officer, Steve England , and Mayor, Bob Leonard was scheduled for July 30th, 2018 at 0900.

Hamlet of Arviat

Senior Administrative Officer (SAO): Steve England

Mayor: Bob Leonard

While in Arviat, the team met with the Hamlet's SAO and Mayor in the Hamlet chambers in hopes of coming to a better understanding as to where the community sits on the spectrum of starting a Canadian Coast Guard Auxiliary (CCGA) unit. Upon meeting the two, the exercise team explained the purpose of their trip. The team emphasized the trip was intended to strengthen relation between the CCG and Inuit communities and address the growing need for awareness and Marine Search and Rescue (SAR) in the North.

In relation to growing need, the community expressed their frustration, "knowing that the Coast Guard has the funding and training available, but we cannot get on the same page" as stated by SAO, Steve England. Emotions were running high as they expressed a community member was brutally mauled and killed by a bear a few short weeks ago. In this situation, they responded to the call with a local's pleasure craft and a nurse aboard. The SAO, emphasized this was a dangerous mission for two unexperienced personnel to partake in.

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To begin, there is a need to understand the Hamlet of Arviat in itself. Population wise, Arviat is one of the biggest communities in the North, according to the SAO. In the past, the unit had a society, [redacted] The society's SAR unit essentially "handed in the keys one day" ultimately leading to the Hamlet having to cover the acquired $20,000 in debt. As expected, this has left the Hamlet with a negative outlook on the SAR society aspect of joining a CCGA unit.

Knowing the Hamlet's concerns, I have reached out to Darlene Langdon, the person responsible for helping communities fill out the necessary paperwork in order to potentially become a CCGA unit. She has provided the Exercise Team with an in depth knowledge on the benefits of a SAR society. To summarize:

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- 5 or more responsible and trustworthy persons can be appointed
- Ensures the funds earned are only used for SAR activities (there is a separate bank account from the Hamlet)
- Ensures the accountability of the unit
- Allows for fundraising
- Can create their own Bylaws (with approval from the Registries)

The Mayor and SAO, expressed to the team that rather than having a society, they are moving in the direction of structuring their ground and marine SAR units like a fire department (eg. Captain, Chief, Deputy Chief, etc). My suggestion was to potentially appoint these same people (from the fire department structure) they deem as competent, to join the position in the SAR society.

They also expressed they would prefer to keep the financial aspect in the hands of Hamlet council because this way the members can focus on the task at hand. It has also been suggested by [redacted] that if their major concern were to have the Hamlet in charge of the funds, because they know how to handle the money. Then why not suggest a council member to be a part of the society?

The boat they have is a Silver dolphin as displayed in the picture attached. It has a brand new 125 Yamaha engine that has been sea trialed with success. They also have a back-up engine available as well. Hypothetically, if they were to come to terms and create a SAR society, the vessel could use rescue equipment, electronics, radar, etc. In addition, their launch site is on a sand/gravel beach which has the potential to pose some future launching issues, as well because of shallow waters, fluctuating tides, and an un-kept ramp.

In conclusion, at today's time we could not come to a common understanding of starting a CCGA unit in Arviat. In the Mayor's word "today is an impasse," but I have told them I'd relay my concerns to the CCGA should anything change in the future. In getting to know the potential candidates, they have expressed a great concern for the creation of a SAR society because their "concerned that we [the government] were trying to change them rather than listen to what works best for their community". Overall, our experience with Arviat was very positive and they had no problem bringing up potential concerns and showing us around to become more familiar with their world.

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Overview

Over the course of 6 days, July 5th-10th, Brianna and I were able to visit the Coast Guard Auxiliary Units in both Yellowknife and Cambridge Bay. During our visits we were able to meet and work with multiple members from each unit in order to grasp a better concept of where the units are at with their knowledge base and SAR skill levels.

Cambridge Bay CCGA

[redacted]

While in Cambridge Bay, we met with only two of the unit's auxiliary members as it was a holiday weekend in celebration of Nunavut Day, meaning not many of the members were available. The unit is comprised of 12 members but they are planning to expand as they will be receiving a new boat next summer. The two members we met with have both completed their Phase 1 and Phase 2 training and the unit leader indicated that having people in the unit capable of instructing the Phase 1 and Phase 2 is beneficial. While on site, we were able to see the one vessel that the unit operates for training and search and rescue tasking's. The vessel is a smaller, single engine boat that was given to them by an RCMP unit years past. The unit does have a second vessel that is an open top Boston Whaler but it is not currently in use as there are issue with the engine. This secondary vessel is often used in more shallow areas but is not good for long distances or any kind of weather outside of clear skies.

We were unable to plan an exercise with the unit as there were only 2 available the days that we were in Cambridge Bay. Although we could not complete an exercise, one of the unit members took us out on the boat so that we could observe a small portion of their SAR area. During this time, it was explained that local knowledge and zone familiarization are very important as there are no charted waters in the area. One of the members uses an IPad equipped with Navionics, which allows a better visual representation of the waters but still lacks aspects such as water depths. There is one elder in the unit that has been training other members on the local knowledge of the area but he is experiencing health issues, which limits him from training with the crew.

The unit members indicated that it is not always the easiest to gather everyone, every week for training but they do so as often as possible. They plan on having a better established plan on how to gather all their members more often and hope that by growing the unit, it will allow them to be more readily available for set training days. It was also mentioned that communication between community members and JRCC is near non-existent. Normally a distress call will come directly to one of the unit members and they will have to call JRCC to relay the call in order for them to receive proper tasking and their insurance coverage to respond. The unit is trying to make it more known in the community who they need to call if they are in need of help.

The unit members voiced some concerns/ suggestions for improvement of the Coast Guard Auxiliary program as well as their specific unit that would help benefit the members. As a unit, the areas that the members wanted to voice concern about were as follows:

- Funding for training and upgraded amenities/gear.
    - The unit's source of income is fundraising within the community (Bingos, community fundraisers) but it becomes difficult in such a small community. Having more funding available will help critically.
    - Local knowledge is essential for their unit and having more members well acquainted with the area is crucial for their search and rescue efforts. Being on the water more often will help to accomplish this.
    - The units gear storage was given to them and it requires some improvements in order to house all of their equipment in one location, rather than transporting it back and forth every time they are training or on a tasking.
    - Upgraded gear: The unit is currently in need of more PPE that is specific to the varying climates in which they are tasked in. The unit currently only has 3 mustang floater suits and they are hopeful to be able to have more as well as dry suits for more adverse conditions.

The units concerns were a matter of funding (most of which is done on their own) which would be used to improve their unit and the equipment that they use and growing their unit in order to operate the new boat efficiently and safely, no matter what crew is operating during a tasking.

Overall, the Cambridge Bay Auxiliary Unit is doing well in terms of operations and they are very capable of handling a large range of SAR scenarios that they may be faced with

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Overview

During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill. On the date of Sunday, July 29 through Tuesday, July 31, 2018 the exercise team visited the small Hamlet of Chesterfield Inlet, in hopes of determining the interest for a CCGA unit. The SAO was out of town [redacted] so instead we had meetings with the following people: financial officer, RCMP officers, and Hunters and Trappers Organization (HTO). Our meetings were scheduled for Monday, July 30, 2018.

Hamlet of Chesterfield Inlet

<u>Senior Administrative Officer (SAO):</u> Roy Mullins

<u>Mayor</u>: Simionie Sammurtok

Upon arriving in Chesterfield Inlet, we quickly discovered how small the community actually was. There are no taxis, everyone knows everyone, and everyone is willing to help each other out. While being shown around by one of the locals, we ended up stumbling upon CG1400 making their first zone familiarization tour to Chesterfield Inlet. Conveniently, earlier that day we got the contact for the [redacted] Co-Op, [redacted] CG1400 would, buy gas from. After successfully beaching the RHIB, we were able to find a temporary solution of many jerry cans to re-fuel.

Knowing the importance of fuelling for CG1400, this was one of the topics that were discussed in the meeting with the finance officer. The idea of potentially getting a barrel that can be put in a truck with a long hose/pump that can be backed up towards the pier when needed. If it's past operation hours, we got [redacted] the Co-Op) contact information- she would then be able to contact the gas attendant. Roy returns [redacted] and I plan to follow up with an email reinforcing everything that was discussed with the finance officer. (Was sent shortly after, but heard no response).

During this first meeting, we discovered that the community's main source of notifying authorities of a distress is by phone to a family member, SAT phone, and SPOT devices. The Hamlet offers boaters/hunters to borrow a SPOT device that can be signed in and out. This can be activated within the event of an emergency. GPS coordinates will be provided. This SPOT device in addition to a satellite phone save someone's life a few short days ago.

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For docking, there are essentially two options: the floating dock, or the beach landing where the barge comes in. During low tide, there is not an option to dock at the floating dock as it is way too shallow. In this case you would need to beach right near the barge landing. When looking for this from the water, you can use the gas center buildings as reference (see picture). According to the locals, tides are changing every six hours so that is something to consider when making an approach to the wharf. See the attached picture for visual of gas buildings.


The picture on the left is the floating dock at medium tide and the picture on the right with the white cylinder building is the fueling station.

After meeting the finance officer, we met up with [redacted] the Hunters and Trappers Organization (HTO), [redacted] She referred us to [redacted] an elder in the HTO. They expressed to us that just 4 days ago they had to rescue a boat that broke down about 2 hours away in severe weather conditions. [redacted] took out their personal boat, a 21ft Silverdolphin and successful rescued the stricken vessel who was on his way to Naujaat for narwhale hunting. Thankfully, the boater had a satellite phone aboard to make contact with a community member ashore. They reinforced there is great interest for a Search and Rescue unit. Although the boat is in good working condition, he expressed a need for rescue equipment and new electronics (eg. GPS).

We discovered that since the last meeting with the Coast Guard, there has been a new mayor and SAO elected. Thus, this means there are some topics that need to be re-discussed with the current SAO, Roy Mullins. The financial officer, Lilian also made us aware that there are two sea cans filled with Coast Guard Environmental Response equipment.

Around the community we've seen posted for interest in joining the CCGA unit and there have been names that signed up. As well as, we have noticed that many already partake in SAR activities when it is necessary to rescue community members. There is a great interest in a CCGA unit and there is clearly a need because it is a high traffic area with less than pleasure craft trying to make their way to

Rankin Inlet, Naujaat and others for hunting. A barrier that will need to be overcome is the lack of interest with the paperwork aspect of SAR. In my opinion, it would have to be put in the hands of a responsible person and would be more beneficial to provide thorough teaching or a simplified checklist.

In addition, we met with the RCMP officers (Miranda and Craig) within the Hamlet who were happy to hear there was a full-time IRB base in Rankin Inlet. At this time, RCMP does not have any boats and they are not water trained. We've exchanged contact information and it is my intention to pass along CG1400's station contact information should they have any questions or concerns when they make their way to Chesterfield Inlet. They also suggested that in order for the SAR unit keep the interest of the community perhaps there can be someone to come in frequently from a close by location to do some training on a regular basis. They threw out the idea of folk from Rankin Inlet or to even have a leader that helps get organization underway and provide structure to the team members/community members. Their concerns were sustainability of a society, as they mentioned that the community eventually loses interest unless there is something to continuously engage them. In their words, "the community works better knowing they are a part of something, which is why it needs structure or leadership".

We also met with the local health center where we spoke with a nurse to get a better understanding of the resources available should there be a tasking that requires medical service around Chesterfield Inlet. Although there resources are limited, they have the lifesaving equipment and drugs necessary to stabilize the patient in preparation from medevac to Winnipeg or Rankin Inlet if necessary. At all times, there is a nurse on call. A lot of these health care individuals have speciality training and lifesaving experience.

In conclusion, there is a lot of potential in Chesterfield Inlet! There is great interest in the community with a Search and Rescue unit. We've also found that there would be much room for community awareness programs (eg. Sail plan, Lifejackets, Cold water) within the schools and with the locals. However, it is important to note that these ways of operating have been passed down through generations, thus this process will be a slow, but important movement in the direction of increased safety. From what we gather about the children, they are extremely receptive to us and were not shy with saying hello. For the future, we feel it would be nice to bring things to give away to the community (eg. Hats, pens, pins, key chains, etc.). In my opinion, this trip was a great success from meeting up with Rankin IRB, to establishing important contacts within the community.

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Important Contacts

RCMP 867-898-0123 After hours: 867-898-1111 Miranda.Michael@rcmp.grc.gc.ca Craig.Lowe@rcmp.grc.gc.ca	[redacted]
Hunter's & Trappers Organization [redacted] 867-898-9063	*Senior Administrative Officer (SAO)* Roy Mullins 867-898-9951 Sao_hamlet@qiniq.com
[redacted]	*Co-Op Manager* [redacted] 867-898-9975

Overview

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During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill. On the date of Sunday, August 5th through Tuesday, August 7th, 2018 the exercise team visited the Community of Churchill, in hopes of SARexing the newly established CCGA unit. The meeting consisted of 8 SAR unit members.

CCGA Unit of Churchill

[redacted]

Approximately two weeks prior to arrival, the exercise team was in contact with the unit leader, [redacted] We scheduled a meeting for 0900 on August 6. Upon arriving to the location we were supposed to meet, it was established that essentially no members could attend because they were in the peak of their tourism season (Beluga Whales). A big factor was that all the vessels are used for tours because they have an MOU with the tour company. Basically all the members also work for that same tour company.

In addition, [redacted] had to leave town for a job opportunity. The crew explained that they started with approximately 30 members, but now are at only about 10 members because they are a seasonal town and only a few of the locals stay there year round.

Luckily, after their work day members were able to attend for dinner. During the meeting, the crew expressed a great interest in formed training days as well as additional Phase 1 and Phase 2 training for new members. At the moment, they do not meet weekly, but try to meet monthly. However, a lot of them expressed interest in training more frequently. Something to note is their ability to rescue depends heavily on the tides, which fluctuate every 6 hours and advance by 45 minutes in a day.

Since becoming a newly established unit in 2017, they've had a couple rescues for disabled vessels who ran out of fuel. In addition, their boats are in exceptional working condition as they are kept clean and functioning for the daily tours.

For the future, they have been encouraged to keep up with their training and attempt to recruit new members if possible while keeping long term members current on their Phase 1 and Phase 2 training.

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Overview

Over the course of 2 weeks, August 8th-21st, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the communities of Iqaluit, Pangnirtung, Clyde River and Pond Inlet. During our visits we were able to meet and work with multiple community and auxiliary members in order to develop a better understanding of where the CCGA stands in each community.

Clyde River CCGA

[redacted]

While in Clyde River, we met with 5 members of the 9 person unit. These members were: [redacted] The unit has very recently been approved to become a society so the members are still completing their application forms to become registered CCGA members. During our visit, we were able to speak with the members about their questions and concerns as well as complete an inspection on their vessel. We also asked the members about any Coast Guard vessels that have been in the area but none could recall having any near Clyde River any time in the recent past.

The unit in Clyde River fundraised over the last year + in order to purchase a vessel from another member of the community. This vessel is a 28 foot aluminum hull that was built in 2014 by Fab Tech Industries. The vessel is navy blue in colour with twin 150 HP Honda outboard engines. It has a max speed of 40 mph and a fuel capacity of 299 litres.

The vessel body looked to be in decent condition, some wear and tear over the hull but nothing overly extreme. The engines looked to be brand new, a little wear on the skegs but both propellers were in excellent condition. The interior of the vessel is very basic; two fuel tanks, both in the stern, one on the port side and one on the starboard. Inside of the cabin, the pane of glass on the starboard side is cracked but the inside of the cabin is in decent condition as well. The trailer of the boat was in excellent condition and of good capacity for the size of the boat.

There were a few issues with the boat that the auxiliary members informed us of:

- Rewiring for the engine trim was just completed by one of the members.
- Throttle cables are not functioning properly.
    - Member has been trying to get a part for it but it is not easy to acquire in the Hamlet.
- Leak somewhere in the steering fluid line for the starboard engine.
- Navigation lights are not currently functioning.
- Radar unit is not functioning

Some of the concerns or questions that the unit had are as follows:

- Training for the auxiliary members once the unit is completely up and running
    - Phase 1 & Phase 2
    - ROC-M
    - First Aid?
- Need for most, if not all safety equipment
    - MISSING:
        - PFD's
        - Flares?
        - Fire Extinguisher
        - Navigation lights
        - Magnetic compass
        - Oars
        - Re-boarding device
    - Vessel equipped with:
        - Manual Bailer
        - Watertight flashlight
        - Sound signalling device
        - Buoyant heaving line
        - Anchor w/ 15m rope

Overall, the Clyde River CCGA is doing very well and have already demonstrated that they are a motivated group of individuals that will be an asset to marine SAR in the arctic. The vessel that the unit has purchased needs a little bit of work to become fully seaworthy but will be a well-suited vessel for their area of operation. Most, if not all of the joining members are already a part of land SAR in the area and are very knowledgeable when it comes to SAR situations. With the proper marine training, Clyde River will be completely ready to respond as a Canadian Coast Guard Auxiliary unit.

Overview

During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill.

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On the date of Wednesday, August 1st through Friday, August 3rd, 2018 the exercise team visited the Hamlet of Coral Harbour, in hopes of determining the interest for a CCGA unit and following up with the Coast Guards previous meeting with them in February 2016. The mayor, SAO, and a few local SAR team members [redacted] attended the meeting. Later, I was also fortunate meet a medical evacuation team and the conservation officer. Our meetings were scheduled for Thursday, August 3, 2018 at 0930a.

Hamlet of Coral Harbour

<u>Senior Administrative Officer (SAO):</u> Leonie Pameolik

<u>Mayor:</u> Willie

Due to extremely foggy and rainy weather conditions, SAO Leonie Pameolik advised me that the turnout at the meeting was smaller than was expected. This meeting took place at the Hamlet in the chambers. They explained that approximately two years ago, about 5 Coast Guard members visited to discuss potentially starting a CCGA unit. I started with trying to gain a better understanding of what took place at his meeting. They described the meeting as a large quantity of people, speaking about the process of starting a CCGA. They were not specific with the outcome of the meeting, but felt it was better for a smaller gathering because then they were able to ask more questions.

During our meeting, we discussed a variety of topics including the following: current level of interest in CCGA, capability of starting a SAR unit, concerns, and common types of rescues. Currently, they have SAR members established, but from my understanding have yet to establish a SAR society. However, they feel they have 5 or more responsible and reliable members that would be willing to fill out the appropriate paperwork to get the process started. I suggested I get them in contact again with Darlene Langdon who would be able to help them with the appropriate steps. Unfortunately, I was unable to show them the form because they had a search that just came about for a member that didn't come home last night from hunting.

Right now, their searches are typically activated from those community members with a satellite phone, a SPOT device, or by members coming up missing when they are expected at a certain time. At this point, locals use their personal vessels to go out for rescues. They described Coral Harbour as a "hub" for boaters making their way to Naujaat for hunting or Rankin Inlet.

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[redacted] one of the local SAR members offered to show me aboard his seaworthy vessel, which is currently at anchor in the harbour. They use dinghies to get to their boat from shore. Others launch their boat from the harbour beach. [redacted] boat, as displayed in the picture below, is a trustworthy 35 foot vessel that has a GPS, inboard motors, radar reflector, and standard safety equipment. One of his concerns is he is unable to find paper charts for the area, and because his boat was bought from Nova Scotia "it still thinks it's in Nova Scotia." He also has another boat on shore, its exterior is in good condition, but [redacted] states it needs a new engine. He states "he needs to install a transducer for the depth sounder and another anchor" in the event he needs to anchor in adverse weather conditions.

As with every Northern community, lifejackets are not really present. It would be rare to see one. This was a topic of discussion during our meeting, as well. They expressed great interest in the phase 1 and phase 2 training.

In conclusion, they feel they are capable of starting a SAR society. I advised I would put in contact with Darlene so they will be able to properly fill out the form to get the ball rolling. At this time, they have some of the means needed to begin a unit, but they will need to solidify the society.

Important Contacts

[redacted] – *SAR member*	[redacted]-*SAR member*
[redacted]	[redacted]

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Overview

Over the course of 10 days, July 13th-22nd, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the Coast Guard Auxiliary Units in Inuvik, Gjoa Haven and Kuguktuk. During our visits we were able to meet and work with multiple members from each unit in order to grasp a better concept of where the units are at with their knowledge base and SAR skill levels.

Gjoa Haven CCGA

[redacted]

While in Gjoa Haven, we met with 6 members the auxiliary unit are all fairly new members as the unit is recently established within the last few years. The unit is comprised of 8 members total and all of the members we met with have their Phase 1 and Phase 2 training completed. The unit does not have a vessel at this time but one is being constructed [redacted] and is expected to be coming this summer on the Sea Lift. The vessel being constructed for the unit is a 26' vessel that will be outfitted with a Yamaha engine and all the required safety equipment according to the regulations. The unit has also been approved for the construction of a new building for the storage of their gear and the boat. The building will be located directly beside the hamlet here in Gjoa. The unit also has a truck that they are able to use for trailering the boat and trailer.

With no boat available and the amount of sea ice still present in Gjoa Haven, we were unable to complete any exercising with the unit. Before meeting with the unit, we were able to speak with the EDO of Gjoa Haven and he explained that the hamlet has been in charge of the units' money up until this point. The EDO informed us that the unit has not submitted any invoices for the gear or boat to him at this point. He informed us that the unit has set up an account [redacted] in Cambridge Bay and was said to have some of their own money. The EDO voiced concern that the resources are being used properly, and that the unit does not communicate effectively as a group.

We were able to sit down with the unit members to discuss their plans for the future when the boat comes and a little bit of what is expected of them as a group. We explained how important it is for the auxiliary unit to work and train together in order to become more familiar with SAR protocols and safety measures that need to be implemented when their new boat arrives. The unit members voiced some concerns/ suggestions for the improvement of their unit that will hopefully help benefit the members. They also voiced some general concerns with the Coast Guard Auxiliary overall. These concerns are as follows:

- Concern of one member not being paid for previous usage of his vessel for training purposes.
    - The member believed he had not received all that he was supposed to in terms of compensation for the rental of his vessel last summer for training purposes.
- Most if not all the unit members have lost their CCGA I.D. cards and were inquiring about receiving new ones

- The unit was curious as to whether or not they will be able to help near-by communities with marine search and rescue, which do not have a unit of their own.
- Unit members inquired about getting different sizes of equipment for their crew as some did not have proper fitting gear.
- As a unit, there have been many inquiries about how to join the auxiliary but none of the members know how to begin the application process for people who wish to join.

There was a great effort made to highlight the proper use and implementation of the following:

- Government assets (i.e. the boat when it arrives, the building where it will be kept, the funding that they receive from the government as well as the gear that they are given) and not abusing them.
- Having the unit there is important for Coast Guard and as a unit being able to properly respond to SAR tasking's according to CCG Standards.
- Training as a unit in order to maintain cohesiveness and proper standards of practice.
- Communication as a unit to make sure everyone is on the same page with each other as well as Coast Guard Auxiliary headquarters in Ontario.
- Fundraising as a unit in order to raise money that they are able to put towards their unit (not relying solely on what funding is given to them).

The units concerns did not seem to be in the same place as other units (Funding, proper gear, etc) but more towards what the unit was receiving. It will be very important to monitor this unit in the near future, with them receiving their new boat and building for their boat as well as the gear associated with it, to ensure it is put to proper use. The communication is very minimal between members and headquarters which is concerning in regards to an operational perspective overall. This unit will need a lot of improvement in the next few years but it will be able to be done with proper guidance and leadership.

Overview

During the third shift of Team 2's travel endeavors, the exercise team consisting of Brianna Quenneville and fill-in crewmember Fallon Weislen travelled to Northern Quebec. With the input of Quebec regional coordinators, it was our main goal to visit communities with CCGA units established. The communities that were to be visited are as follows: Kuujjuaq, Salluit, Inukjuak, and Umiujuaq.

On the date of Wednesday, August 30 through Saturday, September 1, 2018 the exercise team visited the village of Inukjuak to perform a vessel inspection, on-water competency training ,and a small scale on-water exercise for ride checks. In addition, we met held a meeting with about 12 local SAR members, the town manager, the Hunters and Trappers association, and the Fire Chief. A lot of these people were also members of the fire unit and first response team. We discussed their current standards of practice and discuss how it can be standardized and improved.

Inujuak Capabilities of Unit

- ✓ This unit has a new fast rescue craft (Rescue 503), with twin 250 Mercury's in workable condition with the covers cracked
- ✓ Most unit members (approximately 14 members) have Phase 1 and Phase 2 training, however due to timing of the course, they were unable to get on the water for on-water exercises
- ✓ Most members are first responders, thus are comfortable with the medical aspects of the job requirements

Community of Salluit

The new CCGA members of Inukjuak were recently trained in Phase 1 and Phase 2 training (in-class) approximately two months ago at the beginning of the summer. However, due to ice on the bay, the team was unable to get on the water for their on-water competencies. Because there are so many members, we've arranged 4 separate training times over the course of two days with groups of 4 on the vessel. We paired crews of experienced personnel with less experienced personnel. It was our aim to practice the following: launching/retrieving of the vessel, boat handling in close quarters, MOB/PIW approaches, good communication, and dewatering pump use.

Although it is not realistic we'd get through all the material in the short two days with everyone's work schedule and family duties. We found it important to practice as much as we could in the time we were in town, weather permitting.

We learned that currently, they have no set structure for dispatch rather the hunters and trappers take care of the paperwork and organizing team members to go out. The town manager expressed to me that it is one of the goals for them to better understand a structure of how it should be done.

As for the overall condition of the vessel, it could be better maintained. The crew members expressed they have never cleaned it after the use. This is an important consideration for salt water

corrosion of material. In addition, upon our arrival it was clear that the vessel had been used for personal use as it was covered in blood. This being said, it had not been fueled up after they had gone out, which is a concern for future SAR taskings in the future after they get their on-water practical training. They were informed that it should not be used for such things.

In conclusion, it is important to not to underestimate the damage that can be done by sending out inexperienced and untrained crewmembers. This should be evaluated cautiously when allowing crewmembers to use the boat in order to not cause more damage.

For Future

- More on water training
- Better maintenance of vessel (eg. Cleaning the salt water off after each use, sponsons on both sides are damaged)
- Repair of vessels sponsons and radio
- Concerns: Tell members not to use the boat for fishing/hunting. It is strictly used for rescue.
    - Note: I was informed that a vessel technician will be coming to the community next week to repair what could be repaired

Overview

Over the course of 10 days, July 13th-22nd, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the Coast Guard Auxiliary Units in Inuvik, Gjoa Haven and Kuguktuk. During our visits we were able to meet and work with multiple members from each unit in order to grasp a better concept of where the units are at with their knowledge base and SAR skill levels.

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Inuvik CCGA

[redacted]

While in Inuvik, we met with four of the unit's auxiliary members who varied in experience from less than a year to as much as 15+ years. The unit is comprised of 16 members total but they only consider 14 of them to be active members. The two members who are considered to be inactive have been asked to participate within 30 days (whether training or a tasking) and if they do not, they will be removed as members. The unit would like to free up these two spots as they believe it is unfair for someone who would like to join and be an active member, but are unable to as there are no open positions. All of the members we met with have their Phase 1 and Phase 2 training and the unit leader is capable of teaching these courses to new members in the future. While on site, we were able to see the one vessel that the unit operates as well as the 3 SAR Sea-Doos for training and search and rescue tasking's. The vessel is a smaller, single engine boat that is a bit older and the unit is looking into applying for the boats program in order to obtain something that is more suited for the area. One of their Sea-Doos is older than the other two but they are all in good working order and they have a 4th brand new one coming as well.

While with the unit, we were able to plan an exercise consisting of many aspects that related to the Phase 1 and Phase 2 manuals. We were able to complete a fair amount of training with the members of the unit while we were there. After showing us their SAR assets, we began their training regime by having a brief classroom session on how the members are trained before they are allowed to operate a SAR Sea-doo during a tasking. Any member who wishes to operate one has to demonstrate proficiency in Phase 1 and 2 as well as the specific Sea-Doo training that was developed by the unit leader. Following the classroom session, the boat and 3 Sea-Doos were trailered down to the boat launch. Every crew member demonstrated their ability to back the trailers down the ramp safely yet efficiently. We then began a navigation exercise that incorporated safe navigation through the Delta using the GPS, range markers and visual aids. During the exercise, each member was able to properly demonstrate pacing with the Sea-Doo alongside of their larger boat.

Overall the exercise went very well with the Inuvik members. Each of them demonstrated a great deal of competency regarding their local knowledge and navigation skills through a very unique area. Navigating through the delta is comparable to a hedge maze at times because there are so many different channels you could possibly take. Pacing and trailering also showed that the crew is well versed in safe procedures and knowledge of Phase 1 and Phase 2.

As a unit, the members indicated that training does not necessarily happen once a week, but normally when the weather cooperates the most. This means that they may train twice or more a week

and sometime not at all during a week, although they do make an effort to train at least once a week no matter what. The unit uses the Garmin Inreach system as they do not have cellular signal throughout the delta. When they are on a SAR tasking, they will have someone in the office watching them through the online Garmin system, who will also relay messages to JRCC and RCMP for the unit when they are unable to contact them. They also showed us a very useful piece of technology called The Spotted Dog: Rover Pager System. This system allows every members cell phone to act as a pager when they receive a SAR tasking, which in turn the unit members can respond to the page (whether or not they will be responding) directly from their phone. This bit of technology is very cool as it allows them to have a good idea of who and how many will be showing up to respond to their calls. Both the Garmin Inreach system and the Rover Pager System cost the unit money every year out of their own pocket. The Inuvik unit relies very heavily on the fundraising they do as a unit. This has become daunting at times in order to raise enough money for new gear, changing technologies and maintaining their vessels.

The unit members voiced some concerns/ suggestions for improvement of the Coast Guard Auxiliary program as well as their specific unit that would help benefit the members. As a unit, the areas that the members wanted to voice concern about were as follows:

- Funding for training and upgraded amenities/gear.
    - The unit's source of income is fundraising within the community (Bingos, community donations, etc) but this is a lot of work for a smaller number of people.
    - Local knowledge is necessary for their unit as it is such a unique maze of territory, making it crucial for their search and rescue efforts members to be well versed with the area. Being on the water more often helps to accomplish this.
    - Having 3-4 separate units all on searches together and (being on the Sea-Doos) not having the easiest means of communicating, the unit has invested a lot of money into headset communications with little to no subsidization.
    - ** The unit has inquired about using the Canadian Coast Guard fenced yard in order to store their boat and Sea-Doos as they do not have a secured space to do so but they have been told that is not allowed because they are auxiliary members and not Coast Guard personnel. Is there anyone who could look into this for them?

The units concerns come down majorly to a matter of funding (most of which is done on their own) which would be used to improve the unit overall, with focus primarily on communication methods and their older boat.

Overall, the Inuvik auxiliary unit is very impressive with their methods of training and doing well in terms of operations. They are very knowledgeable in their area and highly prepared to handle almost SAR scenarios that they may be faced with on the delta.

Overview

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Over the course of 10 days, July 13th-22nd, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the Coast Guard Auxiliary Units in Inuvik, Gjoa Haven and Kuguktuk. During our visits we were able to meet and work with multiple members from each unit in order to grasp a better concept of where the units are at with their knowledge base and SAR skill levels.

Kugluktuk CCGA

[redacted]

Our visit to Kugluktuk was a little more difficult to navigate than expected. Before we had arrived, efforts were made to get in touch with the unit leader but all attempts were unsuccessful. During our first day in Kugluktuk, numerous calls were made and messages left for the unit leader but none were returned. We were fortunate in the fact that the owner of the Inn where we were staying was a member of the unit. We were able to have a meeting with 3 of the members and spoke with another unit member outside of the meeting. In total, the unit is comprised of 10-12 people and 2 operational boats that belong to 2 of the members. The boats are a 28' enclosed style and a 24' foot open style. The members that we spoke with know for certain that they received Phase 1 training but they are not positive about Phase 2.

Communication with the unit was difficult as we were unable to speak with the unit leader, therefore we were unable to set up on water training and exercising. Instead, we sat down with the unit members that were available to discuss their concerns as a unit and their plan for the future.

- The largest concern with the unit is communication with the south. Jack Kruger was their point of contact and he would come to the community a couple times a year to work with them.
    - Who is now their contact since Jack is no longer with us?
- Not everyone in the unit is fully trained with Phase 1, 2, ROC-M or First Aid
    - Getting instructors here to teach some courses for the unit
    - Need more people certified in order to have sufficient members to drive the boats.
- Hearing of other units receiving boats and new gear but unaware of the boats program.
    - Program was explained. Hoping that further information may be sent off to unit leader.
    - How to apply?
    - More capable boat necessary for longer and farther calls.
- Unit members inquired about having proper gear.
    - Received some gear years ago from Jack Kruger
    - New floater suits?
    - Spot lights (most calls in the fall when it begins to get dark)
    - Night vision?
    - VHF Radios

- Crew would like to train more as a unit but are unsure how to go about receiving funding for their training.
    - Reimbursement process for training
    - Coverage with insurance for their time spent training?
- Fundraising
    - Not an easy thing to accomplish because so many other groups and societies
    - They are an outside agency (Coast Guard) and do not feel as though they will be able to get much from such a small community

Other concerns:

- There is an ER container on site in Kugluktuk from 80's?
    - Unit in need of oil clean up and mitigation courses/ training.
    - More common for cruise ships to be in and out of Kugluktuk, more common for possible oil spills.
    - Beneficial for ER to visit the community. They are interested in helping.
- The radio relay centre/ tower has been shut down
    - People in community are unable to use VHF
    - Crucial for SAR in the area
    - Centre in Inuvik shut down as well?
    - Where is their main point of communications now? Iqaluit? Hay River?

The units concerns were geared toward bettering their unit with what resources possible. They believe that a unit boat that is more capable of handling the adverse weather conditions here would be much more beneficial. They are in need of some gear that will help them on SAR taskings as well. They want to train and receive training but no longer know who their contact is down south. This unit is very willing to participate in more training and are hoping that there will be more presence of Coast Guard personnel in and out of the community to help them train in the future.

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Overview

During the third shift of Team 2's travel endeavors, the exercise team consisting of Brianna Quenneville and fill-in crewmember Sarah Lundin travelled to Northern Quebec. With the input of Quebec regional coordinators, it was our main goal to visit communities with CCGA units established. The communities that were to be visited are as follows: Kuujjuaq, Salluit, Inukjuak, and Umiujuaq.

On the date of Thursday, August 23, through Sunday, August 26, 2018 the exercise team visited the community of Kuujjuaq to perform a vessel inspection, and a small scale on-water exercise for ride checks. In addition, we met with Kujuuaq Police Force, Civil Security Officer, and Fire Chief to discuss their current standards of practice and discuss how it can be standardized and improved. Crew members that attended the SARex were as follows: [redacted]

Capabilities of Unit

- ✓ This unit has a new fast rescue craft (Rescue 513), with twin 250 Mercury's and good condition equipment. Including new depth sounder.
- ✓ Unit members have Phase 1 and Phase 2 training (obtained in 2017).
- ✓ Members have completed on-water training exercises, including training in the past with Helicopters and the Hercules

Community of Kuujjuaq

Being that this was the first unit our team visited in the Quebec Region, it was especially important to determine how their unit was structured, as well as who were the main contacts for each unit. We first met up with [redacted] the Civil Security Officer, and former Fire Chief [redacted] He gave us a history lesson. [redacted] explained that after a canoe had gone missing in the early 2000s the communities realized they needed to improve their marine rescue. The municipality purchased approximately 20 zodiacs, which were given to each community for SAR use. They are currently owned by the municipality and maintained by the community. As expected, he emphasized that some communities take much better care of their vessels than others.

From my understanding, this current structure has been grandfathered into the CCG to incorporate them in the CCGA Q. Contrary to CCGA units around Nunavut, they do not possess a SAR society, but possess the knowledge, skill, equipment, and training to be considered a SAR unit. From what I gather, the fire chief acts as a dispatcher. Typically, [redacted] (Fire Chief) will receive a call, which will then prompt him to activate his crew members. This unit is consisting of about 6-8 consistent members.

[redacted] He suggested that perhaps they can incorporate a standardization for tasking's that is fair to all crewmembers.

As weather conditions were not the most favourable and we only had one vessel to work with, it was difficult to do a more realistic SARex. However, we were still able to do a small shoreline search and a man overboard drill with a buoy. Here we were able to assess their approach, communication, and medical skills of a patient who hit their head. The crew worked very efficiently together, as many of them are also first responders, they were proficient in first aid. They assessed level of consciousness, applied C-collar, and treated our patient for hypothermia.

Given the conditions, we were pleased with what we saw. For the future, we would like to do consecutive days of on-water training. We attempted to do this here, however, it was the weekend and the turn out of the crew members was an issue.

For Future

- Standardize and implement the structure of response... Potentially create a flowsheet for how it is done in other regions (eg. Receive call → Inform JRCC → Get a tasking → Gather CCGA crew + Respond to call → Complete SAR report → Get reimbursement)
- There is great interest by the Kuujjuaq Police Force (KFP) on how they can improve and better understand how it is done everywhere. I suggest a conference call to provide feedback after Northern Quebec tour
    - Discuss: differences, similarities, areas to improve, recommendation
    - Venn diagram?

Overview

s.21(1)(b)

During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill. On the date of Friday, August 3rd through Sunday, August 5, 2018 the exercise team visited the Hamlet of Naujaat, in hopes of determining the interest for a CCGA unit and establishing what stage they were in for creating one. The SAO and his assistant attended this meeting, which was scheduled for Friday, August 3rd at 1pm in the council chambers.

Hamlet of Naujaat

Senior Administrative Officer (SAO): Rob Hedley

Mayor: Solomon Malliki

Upon visiting this beautiful community, it is evident that a lot of the community members are young in comparison to other hamlets. This observation was reinforced by the SAO's statement of 50% of their population is below the age of 13 years old. For this reason, our meeting focused a lot on how to potentially engage future candidates with special focus on methods to reach out to people of that age group.

Given that a lot of the population is young, he advised that recruitment for Iqaluit MCTS and for the CCGA would be best if there was a Coast Guard Representative that came into a high school during their career fair in early spring. He also advised that he would help spread the word for Iqaluit MCTS and recruiting CCGA members by posters around the common community areas.

During the meeting with the SAO, Rob, it was determined that this community is in the beginning stages of starting a CCGA unit. He stated that they have a lot of members that would be reliable and willing to go out to rescue. He also advised that a lot of the members are a part of the rangers and cadets program so they would be good candidates for CCGA recruitment. The SAO is aware of how to contact Darlene Langdon should they have any additional questions or concerns.

Given his past experience, he is comfortable with how to start a society. It his intention this year to get an inventory of all the Search and Rescue equipment they currently possess, in order to establish what they need and what is most necessary for them starting out. [redacted]

A concern he brought to our attention was that a large majority of the time they are surrounded by ice. Their most dangerous concern is when the ice starts to break apart. That is when a lot of their rescues take place.

The exercise team made our way over to Park's Canada to see the role they play in rescue. We determined that they have a good understanding of the area of operation. Also, a lot of their members were currently in the National park for the month of August bringing food, etc. The exercise team also met up with the conservation officer, Peter, who helped us understand specific concerns to this community (hungry polar bears) and what they do to keep their people safe.

s.19(1)

Overview

Over the course of 2 weeks, August 8th-21st, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the communities of Iqaluit, Pangnirtung, Clyde River and Pond Inlet. During our visits we were able to meet and work with multiple community and auxiliary members in order to develop a better understanding of where the CCGA stands in each community.

Pangnirtung CCGA

[redacted]

While in Pangnirtung, we met with [redacted] The Hamlet and some of the auxiliary members recently met in order to decide whether or not there would be a unit in Pangnirtung. Their meetings went well and they have decided to become a SAR society in order to develop a well-established unit for the community.

During our meeting [redacted] we were able to complete a vessel inspection for their 28ft vessel in which they intend to use for SAR purposes. The Vessel was built in 2010 by two of the members within the community. Its main purpose is for pleasure but it is used as a fishing vessel as well. A vessel inspection was completed in accordance to the Audit program used by the CCGA.

There were a few questions and concerns or comments that were brought up during our meeting:

- Currently 3 full members in the auxiliary
  - [redacted] is waiting on 2 more applications to be submitted by possible.
- Proper gear for the members and vessel
  - Properly fitting floatation
  - PPE for more adverse weather conditions
  - Pelican case for SAR gear (SAT phone, etc.)
- Proper training for the members?
  - None of the members have Phase 1 or Phase 2 training
  - Possibly getting an ROC-M or ROC-MC course for the members here

The Pangnirtung CCGA unit looks to be heading in the right direction. They have a vessel that is seaworthy and is in very good condition for SAR purposes. There is a good base of 5 members who are all motivated to improve the unit in the future. With a little more guidance the unit will be able become very well established and grow within the next few years.

s.19(1)

Overview

Over the course of 2 weeks, August 8th-21st, Team 1 of the exercise and training teams (Breagh Harrie and Levi Eegeesiak) were able to visit the communities of Iqaluit, Pangnirtung, Clyde River and Pond Inlet. During our visits we were able to meet and work with multiple community and auxiliary members in order to develop a better understanding of where the CCGA stands in each community.

Pond Inlet CCGA

[redacted]

While in Pond Inlet, we met with two members of the Hamlet; [redacted] and a facilitator who was acting in Pond by the name of [redacted] has been in contact with Darlene Langdon at the CCGA headquarters in regards to becoming a SAR society and the proceeding steps in forming an auxiliary unit. Pond Inlet is in the processing of filing the necessary paperwork to become a SAR Society, in which [redacted] said he would ensure happens this week (August 20th- 24th). Pond Inlet is becoming a very active area for cruise ships, pleasure craft and commercial vessels. This summer alone, they are expecting 23 cruise ships to visit Pond and a small craft harbour is now in the process of being constructed.

[redacted] explained that the land Search and Rescue unit is very active within the community and he believes that there will be a large interest in the marine side of it as well. Once the SAR society has been formed, [redacted] will proceed with registering the two vessels that they have the intention of using for marine SAR purposes. [redacted] informed us that someone from Transport Canada had been to Pond Inlet recently and completed inspections on the vessels for the purpose of licensing and registration. The employee from Transport Canada has the first name of Tamera but [redacted] did not have her last name.

The two vessels were not available for viewing while we were visiting as they were being used for hunting purposes. [redacted] has the necessary paper work that needs to be completed in order to register the vessels with CCGA headquarters. This paperwork will be completed and sent to Darlene Langdon. The following information on the two vessels was given to us [redacted]

Vessel #1:

- Owned by: [redacted]
    - 22 feet (6.7 metres) in length
    - 7.5 feet wide
    - Built in 2009
    - 2x 150 HP

Vessel #2:

- Owned by: [redacted]
    - 18 feet (5.7 metres) in length
    - Built in 2008
    - 115 HP

The Hamlet in Pond Inlet has the intention of creating a SAR Society as soon as possible and is aware of the next steps in the process towards becoming an active unit for marine SAR. With the guidance of [redacted] at the Hamlet and some help from headquarters, Pond Inlet will become a well-used asset in an area that is becoming much busier with on water vessel activity.

s.19(1)

Overview

During shift two of Team 2's Arctic endeavors, the scheduled a Central trip where the following communities were to be visited: Rankin Inlet, Arviat, Chesterfield, Coral Harbour, Naujaat, and Churchill. On July 31st, Brianna and Levi were on an overnight layover in Rankin Inlet during crew change. During this time, it was established [redacted] that we would go on the boat to gain some familiarization with the area in the event that I would have to ever fill in. In this same time, the crew was exercised on the evening of July 31st, 2018.

Exercise Scenario

FOR EXERCISE - During local patrol and zone familiarization, a crew member is fixing a line on the back deck. The helmsman made a sudden turn, and this crew member was thrown from the vessel.

It is presumed he has hit his head, causing him to go unresponsive. The crew was required to act accordingly (eg. CPR, nearest safe haven, activating available assets).

Who was involved: Crew B [redacted]

Where did this take place: Around Thompson Island

Objectives

- ✓ Strong Communication
- ✓ Safe Handling
- ✓ Understanding operating procedures unique to the Arctic
- ✓ Man Over Board Procedures
- ✓ CPR Procedures

What We Saw

As expected, this crew operates slightly differently than most Inshore Rescue Boats. It was the exercise team's goal to better understand unique characteristics of this base. When I asked [redacted] "what do you feel your crew could improve on the most?" He stated that with the late start to the season, there was not much time to focus on first aid because their main focus was navigational training for the first year crew, and zone familiarization. For this reason, I felt it was best to give the crew a chance to see how they operate in a simulated medical scenario.

Something unique about this unit is each time they want to go out on the water they have to trailer, launch, and retrieve their vessel. They go to an area where the barge comes in and launch from a beach. One crew member is

responsible for backing up the trailer and winching, while the rest of the crew is aboard. Upon
s.19(1) launching, the crew aboard beach the boat allowing for the last crew member to board after they park the truck and trailer.

Since the moment we stepped on the boat, the crew was exceptional with closed loop communication, and communication with RCC prior to departure. At all times, you knew what each crew member was doing and where they were going. [redacted] took opportunities for the crew to practice their launching and retrieving skills in various conditions. The crew demonstrated safe operations during: beaching, launching, retrieving, and navigating.

Recommendation

- At every crew change make sure you go through your med kit, as I noticed there was a bit of a lag in finding equipment. This could be deemed an unnecessary risk during a real call requiring medical treatment.
- Train those who are not confident with medical scenarios, thus increasing crew member versatility
- Water boots – for launching purposes you guys are lucky that one crewmember has water boots. This may be a good recommendation in the future for all IRB north students to get some as a part of their PPE.
- Having a practice kit to actually practice vital skills, for example, setting up the oxygen tank and non-rebreather

Overview of Salluit

During the third shift of Team 2's travel endeavors, the exercise team consisting of Brianna Quenneville and fill-in crewmember Sarah Lundin travelled to Northern Quebec. With the input of Quebec regional coordinators, it was our main goal to visit communities with CCGA units established. The communities that were to be visited are as follows: Kuujjuaq, Salluit, Inukjuak, and Umiujuaq.

On the date of Thursday, August 26, through Sunday, August 29, 2018 the exercise team visited the village of Salluit to perform a vessel inspection, and a small scale on-water exercise for ride checks. In addition, we met with local SAR members who were also members of the fire unit and first response members to discuss their current standards of practice and discuss how it can be standardized and improved. Crew members that attended the SARex were as follows: [redacted]

Capabilities of Salluit Unit

- ✓ This unit has a new fast rescue craft (Rescue 507), with twin 250 Mercury's and good condition equipment.
- ✓ Unit members have Phase 1 and Phase 2 training (obtained in 2017).
- ✓ Members have completed on-water training exercises
- ✓ Recent SARex with [redacted] on August 18th
- ✓ Members are well trained medically because it's their primary job

Community of Salluit

With the help of [redacted] we were able to establish contact with SAR unit members [redacted] Firstly, we did a vessel inspection to ensure it had been well kept. Similarly to the unit in Kuujjuaq that we had just been to, they had a Fast Rescue Craft with an enclosed cabin. For storage of this vessel, they too had a garage down by the launch ramp used explicitly for the rescue boat.

Currently, they operate under the same structure as Kuujjuaq where the fire chief notifies the team of a call and they respond. A lot of the members wear different hats within the community as first responders, so one of the members expressed to me that they are concerned with getting burnt out. It has happened in the past where they have multiple rescues in different jobs in one night (eg. Fire + Marine Rescue), but still have to report for work in the morning as this is only a volunteer position.

We practiced their approaches on a MOB procedure, from there we actually put our crewmember in the water to show us the way they use the winch for PIW recovery. They were also able to demonstrate a two person recovery. They also demonstrated how to use their winching device to retrieve a person from the water.

For Future

- Finding an area to clean the boat after each use with a power washer to prevent further eroding and encourages good maintenance
- Set up dewatering pump
- There were modifications made to the trailer, it currently doesn't have safety hooks/chains which could be dangerous for launching and retrieving
- Fixing the hinges on the stern compartments that were eroded by the salt water

Overview

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Over the course of 6 days, July 5th-10th, Brianna and I were able to visit the Coast Guard Auxiliary Units in both Yellowknife and Cambridge Bay. During our visits we were able to meet and work with multiple members from each unit in order to grasp a better concept of where the units are at with their knowledge base and SAR skill levels.

Yellowknife CCGA

[redacted]

While in Yellowknife, we met with ten auxiliary members who varied in time as a unit member anywhere from less than a year to 15+ years. The whole unit itself is 40 members large and contains 6 coxswains. The majority of the members we had met with have all successfully completed the Phase 1 and Phase 2 training except for the few that had join less than a year previous. While on site, we were able to see that their unit has 3 vessels varying in length and capabilities that they are able to use for SAR purposes. These vessels are a Hurricane 633, a Titan 249XL and a 28' Boston Whaler. The unit demonstrated to us a very useful piece of technology that they are beginning to use which allows someone to text their latitude and longitude to another cell phone via the location services GPS feature on smart phones. This piece of technology is something they wish to inform other units of as it is fairly useful if someone does not know their location or is not carrying a GPS on their person during a time of distress.

A small SAR exercise was planned for the unit to complete and some of their more experienced members helped with the execution of the scenario. The units' 28' Boston Whaler departed the dock earlier than the other two vessels to act as the search object for the exercise. When the simulated distress call came in over VHF, the remaining two vessels were tasked to search for a disoriented vessel near "The Fish Plant" with a possible head injury on board. The vessel relayed that there were 3 POB and one of the persons hit their head and had lost consciousness. According to the scenario the unit was given, we wanted to gauge their capability of prioritization of the victim/vessel, communication between crew members and simulated JRCC as well as their overall safety as a crew and the casualties in question.

Overall the exercise went off without a hitch. Each vessel had members with varying skill levels, allowing us to see the overall capabilities of the members and a unit as a whole. Ride checks were conducted for unit members on board 2 of the vessels in order to gauge their knowledge of SMS protocols and SAR situation awareness/skills. The ride checks determined that each crew member was capable of strong communication throughout the entire exercise within their crews, demonstrating proper closed loop communications as well as proper contact with simulated JRCC/ MCTS Iqaluit. Crew members communicated well with the coxswain while determining depths of water and maintaining visual lookout for buoys, hazards and the search object. Both crews worked well together in order to prioritize their resources to transport the patient with the injury quickly and safely while also setting up a tow to have the vessel transported. Each crew demonstrated proper set up of a long tow and saddle

tow while the first aid aspect of the exercise was handled properly, based on the level of first aid the members have obtained (basic first aid).

Concerns from an evaluation perspective were minimal. Everyone followed safe procedures while on board the vessels, when boarding another vessel during the exercise, exchanging casualties from one vessel to another. Some areas of suggested review, for the benefit of maintaining proper procedures, would be as follows:

- Review phase 1 and phase 2 manuals for towing procedure, hand signals when communicating on RHIBs and the best location to have stable patients during transport on the vessel (Stern as opposed to the bow for more comfort.)
- Ensure all information about a disabled or disoriented vessel (e.g. Latitude & Longitude, name of vessel, persons on board, injuries on board, nature of distress, etc.) are recorded as soon as possible in the event that communication with the vessel is lost.
- Ensure that the information is written down and not only inputted into an electronic system in case of electronic failure.
- As a unit, seeing members possessing a higher level of first aid knowledge as they may see some fairly adverse circumstances in a marine setting.

The unit members voiced some concerns/ suggestions for improvement of the Coast Guard Auxiliary program that would help benefit everyone overall. As a unit, the areas that the members wanted to voice concern about were as follows:

- Funding for site specific training of unit members.
    - Local knowledge is a great concern for members as nothing on Great Slave Lake is charted – unit relying on sonar, 'crowd sourced data', and local knowledge in order to navigate. Every member should be well versed with their search area.
    - As a unit there are multiple fuel caches available on Great Slave Lake for longer/farther calls and familiarizing all unit members with their whereabouts is important.
    - Upgraded gear: The unit is currently in need of more PPE that is specific to the varying climates in which they get tasked in. (e.g. Floater suits, proper gloves, proper head wear for adverse weather, etc.)
    - A topic that was largely voiced is that the unit members are no longer able to take one of their boats and help community members that may be in trouble at a nearby in-land lake. (An effort was made to explain that in-land waters are not under coast guard jurisdiction but this did not seem to matter to some of the unit members)

The units concerns came down more or less to a matter of funding (in which they do a large amount of on their own) and equipment for the unit. The Yellowknife unit relies heavily on fundraising and donations in order to supply their members with proper gear and training.

Overall, the Yellowknife Auxiliary Unit is very well established and is highly capable of handling a large range and variation of SAR scenarios that they may be faced with on Great Slave Lake.

Brianna Quenneville & Breagh Harrie – Arctic Exercising and Community Engagement Supervisors

C&A REGION OPP PROJECTS STATUS – EXECUTIVE SUMMARY

26 October 2018

8B100 – OpNet

Nationally, 101 lines total have been modernized, 97 of those have been cutover, and 94 old circuits have been turned down permanently, with 4 waiting for CCG cutover. The key output for modernization for this fiscal year is to have 92 sites modernized, which has been exceeded.

Phase 1 of the cellular backup trial has begun; 10 lines have been installed in C&A. Phase 1 of cellular backup solution implementation, configuration, and testing is continuing. The national target is on track. The regional timelines have been affected by resource constraints in the GL Sector.

8D100 – TERMPOL

The list of qualified PM-05 candidates for C&A has been developed. We are currently awaiting a staffing appointment decision for the PM-05 TERMPOL position in the Strategic Services Unit in IBMS. We will be contributing CCG's perspective to TC's policy options paper, which is slated to be issued in Winter 2019.

8E110 – Regional Response Planning (RRP) Pilot in Northern BC

No updates for the Region for this period. Progress continues on the project in BC with engagement and exercising as well as interdepartmental meetings planned to discuss interdependencies and communication. However, project funding is not planned beyond 31 March 2019, so if a request for additional funding to the Ministry of Finance is not approved, the project will close out on that date.

8F100 – Risk Analysis of Maritime Search and Rescue Delivery (RAMSARD)

All key milestones are on track with the exception of the Arctic, which experienced delays related to staffing. Milestones for the Arctic will be adjusted once more information becomes available. Generally, milestone dates have been revisited now that the project is halfway through the first cycle; it was determined that the RAMSARD cycles will have a 16-month schedule with a four-month overlap between cycles.

The RAMSARD project nationally is facing financial pressures. In region, the main driver of this is Arctic engagement, with a current forecast of $55,272K.

In terms of engagement, Arctic RAMSARD has completed internal engagement end of October; industry engagement will take place at the Arctic Week end of November, and Indigenous engagement will take

place in Winter 2019. The Central team just completed a week-long engagement trip in RAMSARD Area 110 early October, which includes indigenous, provincial and municipal emergency partner engagement.

8G110 – 24/7 ROC

Exams have been conducted for the 90 screened candidates from the third national hiring process. The region will interview five candidates this month, with an expectation of staffing all remaining OPP ROC 24/7 positions. A call-up against an Audiovisual Standing Offer (AVSO) held by Telus for technical (emergency centre) furniture is in process in order to adequately seat new staff in furniture appropriate to the ROC. The installation is scheduled for late November/early December in order to avoid the start of the southern ice season and seaway closure in December. The anticipated cost for the refit is approximately $150K.

Discussions are underway with DFO Real Property to inform the development of options for long-term renovations to fully meet 24/7 ROC project requirements. DFO RP has assigned a designer and a project manager to work on the file; both are aware of the issues and constraints as well as the importance of the project.

The ROC CONOPS is in the DG's office for approval before a formal review meeting is scheduled at the national level after a number of cancellations. The NPM will sit as an observer in this meeting.

With respect to the project budget, a clean-up process is ongoing to identify and recode project charges. Once complete, a forecast exercise to fiscal year-end will be undertaken. The project expects to identify a surplus in O&M funds.

A training curriculum is in development, and in P6 the target for 24/7 operations was moved back from November 2018 to March 2019 in order to free officers for training requirements.

8G300 – MCTS Staffing Factor

Over 40 recruitment sessions are planned for fall 2018 and winter 2019, mostly for MCTS stations in the South (Prescott, Sarnia, Quebec, Les Escoumins).

8H100 – Legislative Changes to Provide CCG with Clarified Authorities for Ship-Source Pollution Incidents

Activity is ongoing at the national level regarding the legislative package, related briefing materials and planning discussions for the different scenarios resulting from possible legislative timelines. There is no regional update for this period for these projects.

C&A REGION OPP PROJECTS STATUS – EXECUTIVE SUMMARY

2 November 2018

8B100 – OpNet

Nationally, 101 lines total have been modernized. 97 of those have been cut over, and 94 old circuits have been turned down permanently, with 4 waiting for CCG cutover. The key deliverable for modernization for this fiscal year was to have 92 sites modernized.

Phase 1 of the cellular backup trial has begun; 10 lines have been installed in C&A. Phase 1 of cellular backup solution implementation, configuration, and testing is continuing. The national target is on track. The regional timelines have been affected by resource constraints in the GL Sector.

8D100 – TERMPOL

The list of qualified PM-05 candidates for C&A has been developed, and a successful candidate has been identified. We are currently awaiting a staffing action to be completed. We will be contributing CCG's perspective to TC's policy options paper, which is slated to be issued in winter 2019.

TC initiated contact with industry stakeholders in Quebec during the Comité de concertation sur la navigation meeting on June 19, 2018. Subsequent discussions with the marine industry, ports and pilots have helped identify the priorities for the new marine safety assessment program, this completes the first phase of engagement in Quebec. A second phase of engagement will include consultation with Indigenous and coastal communities will take place to develop options for the program.

8E110 – Regional Response Planning (RRP) Pilot in Northern BC

Progress continues on the project in BC with engagement and exercising as well as interdepartmental meetings planned to discuss interdependencies and communication. However, project funding is not planned beyond 31 March 2019, so if a request for additional funding to the Ministry of Finance is not approved, the project will close out on that date.

In Quebec, DFO is currently in discussions with the secrétariat aux affaires du Québec to have access to provincial and municipal data. This will help complete the charting of environmentally and socioeconomically sensitive areas (due March 31, 2019), and would conclude the Area Response Plan (ARP) data assessment for DFO. For C&A, there are four FTEs positions allocated to the RRP project, three of which are staffed. As the RRP project is focused on the northern BC area at this time, the other regions are awaiting lessons learned to determine next steps.

8F100 – Risk Analysis of Maritime Search and Rescue Delivery (RAMSARD)

RAMSARD Arctic

Milestones for the Arctic have yet to be adjusted following the return on strength of the Arctic RPM in August. The Arctic RAMSARD project is also contributing to financial pressures in the project nationally, with a current forecast of $55,272K for engagement activities.

With respect to engagement, Arctic RAMSARD has almost completed internal engagement (16 SMEs have been interviewed), although progress on the substantive content of the report continues to be slow. Meanwhile, the RPM has chosen to focus on academic Arctic SAR studies to inform the development of the report.

Industry engagement will take place at the Arctic Week end of November in Yellowknife, where the RPM will be on the AMAB agenda to present RAMSARD and invite industry members to participate in the study. Indigenous engagement will take place in Winter 2019. No firm plan has been developed yet, which may pose a risk to the project's operational and engagement milestones; the engagement indicator has been changed to yellow to reflect this.

RAMSARD South

Generally, milestone dates have been revisited now that the project is halfway through the first cycle; it was determined that the RAMSARD cycles will have a 16-month schedule with a four-month overlap between cycles.

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The Central team just completed a week-long engagement trip in RAMSARD Area 110 (Kingston to Cornwall) early October, which includes indigenous, provincial and municipal emergency partner engagement. The next area to be reviewed is SAR area 140 (Cornwall to Grondines).

[redacted] after March 31, 2019. The RAMSARD Arctic RPM will take over at that point.

8G110 – 24/7 ROC

On staffing, the Region will interview five candidates this month, with an expectation of staffing all remaining OPP ROC 24/7 positions.

A call-up against an Audiovisual Standing Offer (AVSO) held by Telus for technical furniture is in process in order to adequately seat new staff in appropriate furniture. The installation is scheduled for late November/early December in order to avoid the southern ice season and seaway closure in December. The anticipated cost for the refit is approximately $150K.

Canadian Coast Guard
Correspondence Routing Slip

Fiche d'acheminement de correspondance
Garde côtière canadienne

To: / Pour: Julie Gascon, Director General, Operations

Date: NOV 0 5 2018

Object: / Objet: **OPP RAMSARD - PROJECT CHANGE REQUEST 8F100-H-100**

From / De: Ryan Tettamanti, A/Director Incident Management

☐ Your Signature / Votre signature

☐ Information

☐ For Comments / Observations

☐ Material for the Minister / Documents pour le ministre

Remarks: / Remarques:

Drafting Officer/ Rédacteur: Yasmine Clarke 613-851-8275 / SD / RT

Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Coast Guard | Garde côtière canadienne

CLASSIFICATION
GCCMS #: 2018-012-00812
EKME #: 3980086

MEMORANDUM FOR THE DIRECTOR GENERAL OF OPERATIONS

APPROVAL OF OPP RAMSARD PROJECT CHANGE REQUEST 8F100-H-001

(Signature)

SUMMARY

- In P6 OPP RAMSARD Project was identified as "remediation required" due to in-year financial pressures. A Project Change Request (PCR) was submitted to the OPP secretariat through OPP Change Management Process.
- The OPP Secretariat has approved the risk-management of the RAMSARD financial pressures within the OPP envelope as signed in the PCR (tab A).
- Approval of Project Change Request from DG, Operations as the project sponsor is required in order to increase allocated funding (tab B).

In-year financial pressures:

Costs associated with the elaboration of a Mass Rescue Operation (MRO) National Coordination plan: $137,000 ($77,000 in Salaries (110) and $60,000 in O&M (120)).

- The RAMSARD methodology requires assessment of risks associated with major SAR incidents.
- The MRO National Coordination plan will assess and map area capabilities and will provide input into Coast Guard response preparedness in the event of a major SAR incident. This work is therefore intrinsically connected to RAMSARD; a MRO chapter is included in each RAMSARD review report.

Engagement Requirements ($47,500)

- Engagement gifts in the amount of $22,500 is requested to express departmental gratitude in support of engagement sessions.
    - There is no DFO/CCG policy or direction regarding gifts to external representatives however, the requirement for such direction has been identified both by outreach and IRP staff. In the interim, RAMSARD analysts will continue to follow IRP guidance for distribution of gifts, where token gifts will be the norm, but higher value gifts will be reserved for indigenous elders, village or city mayors and other significant representatives.
- Oral Translation Services in the amount of $25,000 are are also required for some of the Indigenous engagement sessions on the Labrador coast.

Translation Requirements ($15,000)

- A full translation of the amended RAMSARD methodology volume I and II is required in order to abide by the Official Language requirements.

National Project Management Meetings ($32,000)

- Additional funding is requiredto enable regional participation in the RAMSARD training week and RAMSARD Cycle 2 Kick-Off meeting.

Arctic Engagement ($55,272.22)

- Additional funding is required to complete the required engagement activities and Project Management travel an increase of $55,272.22 is required (Tab B).

[redacted]

PROJECT CHANGE REQUEST NO: 8F100-H-001

Date:	September 12 2018
Project Code:	8F100
Project Title:	Risk-based Analysis of Maritime Search and Rescue Delivery
Region: (if applicable)	HQ
Work Breakdown Structure Element(s):	1.1.8.4.1, 1.1.9.4, 1.1.8.2.3 and to be created.
Requested By:	Project Manager RAMSARD

Identification:

Change Title:	Increase of funding for FY 2018-19 without pay back.
Description of Change:	The following in-year pressures have arisen resulting in the need for additional project funding: 1- Costs associated with the completion of a Mass Rescue Operation (MRO) National Coordination plan: \$137,000 (\$77,000 in Salaries (110) and \$60,000 in O&M (120) 2- Engagement requirements \$47,500 3- Translation requirements \$15,000 4- Costs associated with National Meetings \$32,000 5- Arctic Engagement \$55,272.22
Justification:	The purpose of this Oceans Protection Plan (OPP) project is to implement a risk-based analysis of maritime search and rescue delivery (RAMSARD) methodology nationally within the Canadian Coast Guard which will support planning and decision-making within the agency. Costing for the RAMSARD project that was submitted through the OPP Treasury Board submission process was completed during the early stages of the project and has since been found to have omitted some funding requirements. At the moment the project has several pressures: 1- Mass Rescue Operation (MRO) National Coordination Plan (\$137,000 (\$77,000 in 110 and \$60,000 in 120)) The RAMSARD methodology requires assessment of risks associated with major SAR incidents, with respect to the adequacy of response capabilities in the area to deal with such occurrences. Work is underway to develop a Mass Rescue Operation National Coordination plan, which will assess and map area capabilities and will provide input into Coast Guard response preparedness in the event of a major SAR incident that overwhelms Coast Guard resources. This work is therefore intrinsically connected to that of RAMSARD. 2- Engagement Requirements (\$47,500) The RAMSARD methodology requires that stakeholder/partners/clients are fully engaged in the RAMSARD review process. It allows RAMSARD analysts to identify marine risks in their areas, and also provide validation of the risk scenarios and mitigation strategies developed. Ensuring stakeholder/partners/clients are fully engaged in the review process and its findings will help secure their support of the initiative. Therefore the foundation of the RAMSARD process, including the Environmental Scan, is based on engagement with stakeholders, including; (federal OGDs), SAR delivery partners (provincial and territorial agencies), Indigenous communities, volunteers (Canadian Coast Guard Auxiliary), and Clients (maritime users: recreational, sports, fishing, and industrial communications principles and public relations).

[redacted]

It has been found that offering culturally appropriate token gifts at the beginning of the engagement sessions sets the tone for successful meetings. It is a sign of appreciation for the client's time and, an important part of Indigenous culture.

Original costing for the RAMSARD project omitted funding for engagement gifts or any Vote 10 funding. RAMSARD has mitigated this risk by leveraging other engagement opportunities.

As such, the project is requesting immediate funding of $7,500 per Region for a total of $22,500 to acquire engagement gifts. RAMSARD is required to assess all of the Search and Rescue areas within the 5 year timeframe, where each Region will be required to assess a minimum of 2 to 4 areas on a yearly basis. This requirement will therefore remain a yearly funding pressure as it was not included in the original estimates.

In addition, oral translation services are required for some of the Indigenous engagement sessions on the Labrador coast. This requirement has put an additional pressure of $25,000 on the project.

3- Translation Requirements ($15,000)

The 2018-19 key outputs identified in the TB Submission called to identify lessons learned from initial process and amend the methodology and review process. As such the project is amending the methodology where required. As this is the first full national implementation the document has undergone some significant aesthetic changes in order for the Analysis team to better understand how to implement the methodology. A full translation of the RAMSARD methodology volume I and II will be required in order to abide by the Official Language requirements. This requirement was not identified in the original costing.

4- National Project Management Meetings ($32,000)

The project is currently suffering a pressure of $32,000 for regional participation in the RAMSARD training week and RAMSARD Cycle 2 Kick-Off meeting.

5- Arctic Engagement ($55,272.22)

Central and Arctic received an O&M budget of $75,600 to review 5 areas which included the Arctic. The budget for the Arctic is $40,000. Given the remote locations and the need to send more than one FTE on these engagement sessions, this budget is insufficient to engage with targeted communities. The strategy being used is to use existing information from previous engagement sessions done in the past two years. However there is still a need to do targeted engagement sessions with some communities (currently being defined) as well as significant industry engagement (by phone, e-mails and face to face) in order to collect the required information to produce the Environmental Scan and confirm validity of stats. In order to complete the required engagement activities and Project Management (PM) travel an increase of $55,272.22 is required.

Is this a request to access project Contingency funding?		☐ Yes	☑ No
Is this a CARRY FORWARD request?		☐ Yes	☑ No
Type Of Change:	Arising ☑ Minor ☐ Major	New Work ☐ Minor ☐ Major	**Must select one:** ☑ National Budget Increase/Decrease ☐ Internal Budget Reallocation(within project) ☐ Schedule ☐ Other (i.e. scope change only, no budget adjust)
Change Priority:	☐ Low	☐ Medium	☑ High

[redacted]

Impacts:

Background	
Technical	
Performance	
Schedule	

Financial

Current Year (CYBA) Adjustment ($000's)			
	Current	New	Delta
ATL	$	$	$ 0.0
C & A	$ 282.2	$ 337.5	$ 55.3
WES	$	$	$ 0.0
NCR	$ 206.9	$ 438.4	$ 231.5
NATIONAL	$ 0.0	$ 0.0	$ 0.0
Contingency	$	$	$ 0.0
Current FY + 1	$	$	$ 0.0
Current FY + 2	$	$	$ 0.0
Future Years	$	$	$ 0.0

Additional information (or see attached detail worksheet):

Risk

There is a risk of not completing to the following 2018-19 Key Outputs should these pressures remain unfunded:

1- Complete a summary of findings and recommendations for presentation to Management Boards and Partners.

The MRO plans are required in order to complete the Major Maritime Disaster chapter in the RAMSARD reviews.

Funding for translating services are required in order to have successful engagement meetings with the Labrador communities as part of the area 009. CCG will not be able to engage with the communities who do not speak English or French.

Face to Face meetings for the analysis team are crucial to the development of findings and recommendations as part of the first National implementation of the RAMSARD. It also ensures the Regions are progressing together and applying standardization and enabling quality reports.

Funding for the translation of Edition 2 of the RAMSARD manual is required for Official Languages and permitting everyone to provide feedback in the language they are most comfortable with.

If the Arctic cannot execute their engagement plan, the information collected will be incomplete leading to a partial analysis which will affect the credibility of the conclusions/recommendations in the report.

[redacted]

	2- Identify lessons learned from initial process and amend the methodology and review process. Face to Face meetings for the analysis team are also crucial in order to share our lessons learned as we progress and amend the methodology where required.
ILS	
Contractual	
Program Delivery	
Scope	
Other	
Configuration Change	Is the work described in this PCR subject to the CCR Process? ☑ No ☐ Yes CCR Registration Number: NA

Recommendation:

Recommended Action:	It is recommended to provide RAMSARD with an additional 286.8K to fund the financial pressures. This additional funding is to increase the project's Total Estimated Cost (TEC) with no pay back.
Action Due Date:	October 5th, 2018
Recommended By:	Project Manager RAMSARD

[redacted]

Approvals:

		Date:
☐ Recommended ☐ Not Recommended ☐ See Comments	Yasmine Clarke Yasmine Clarke, Project Manager RAMSARD	October 1st 2018

OPP SECRETARIAT		
Finance Analyst	Change Cost Analyst	* Project Management Lead 18.10.2018.

		Date:
☑ Recommended ☐ Not Recommended ☐ See Comments	Sheyla Dussault, Project Leader RAMSARD	31 oct 2018
☐ Recommended ☐ Not Recommended ☐ See Comments	~~Derek Moss,~~ Project Director RAMSARD Ryan Tettamanti	29 OCT, 2018
☑ Approved ☐ Not Approved ☐ See Comments	Julie Gascon, Project Sponsor RAMSARD	NOV 0 5 2018
☐ Acknowledged	Simon Melanson, Senior Director OPP	

* Engagement: Is it not the regional Hub that does engagement? Travel is being closely monitored & questioned. Who needs to participate.

[redacted]

Project Change Request:

WBS #	Description	CCR #	Maximo WO #	Current	New	Delta
TBD	Mass Rescue Operations Portion of AS-06 Salary Pressure (110)			$ 0	$ 77,000	**$ 77,000**
TBD	Mass Rescue Operations Expert Panel Meeting (120)			$ 0	$ 60,000	**$ 60,000**
1.1.8.4.1	HQ Travel for Business (120)			$ 30,000	$ 32,000	**$ 62,000**
1.1.9.4	Translation HQ (120)			$ 700	$ 15,000	**$ 15,700**
TBD	Translator Services for Engagement (120)			$ 0	$ 25,000	**$ 25,000**
TBD	Engagement Tokens Gifts Various (120)				$ 22,500	**$22,500**
1.1.8.2.3	Arctic Engagement			$40,000	$55,272.22	**$95,272.22**

Fisheries and Oceans Canada | Pêches et Océans Canada
Canadian Coast Guard | Garde côtière canadienne

Annex B: Environmental Scan

SAR Area 155

Maritime Search and Rescue Arctic Analysis

Canadian Coast Guard
Search and Rescue Risk Analysis
March 2019

Annex B: Environmental Scan – Area 155

The Regional SAR Risk Analysts for the Arctic would like to extend acknowledgement for this Environmental Scan to the following organizations:

Canadian Hydrographic Service
Canadian Ice Services
Department of Fisheries and Oceans
Environment and Climate Change Canada
Joint Rescue Coordination Centre Trenton
National Oceanic and Atmospheric Administration
National Aeronautics and Space Administration
Oceans Ltd

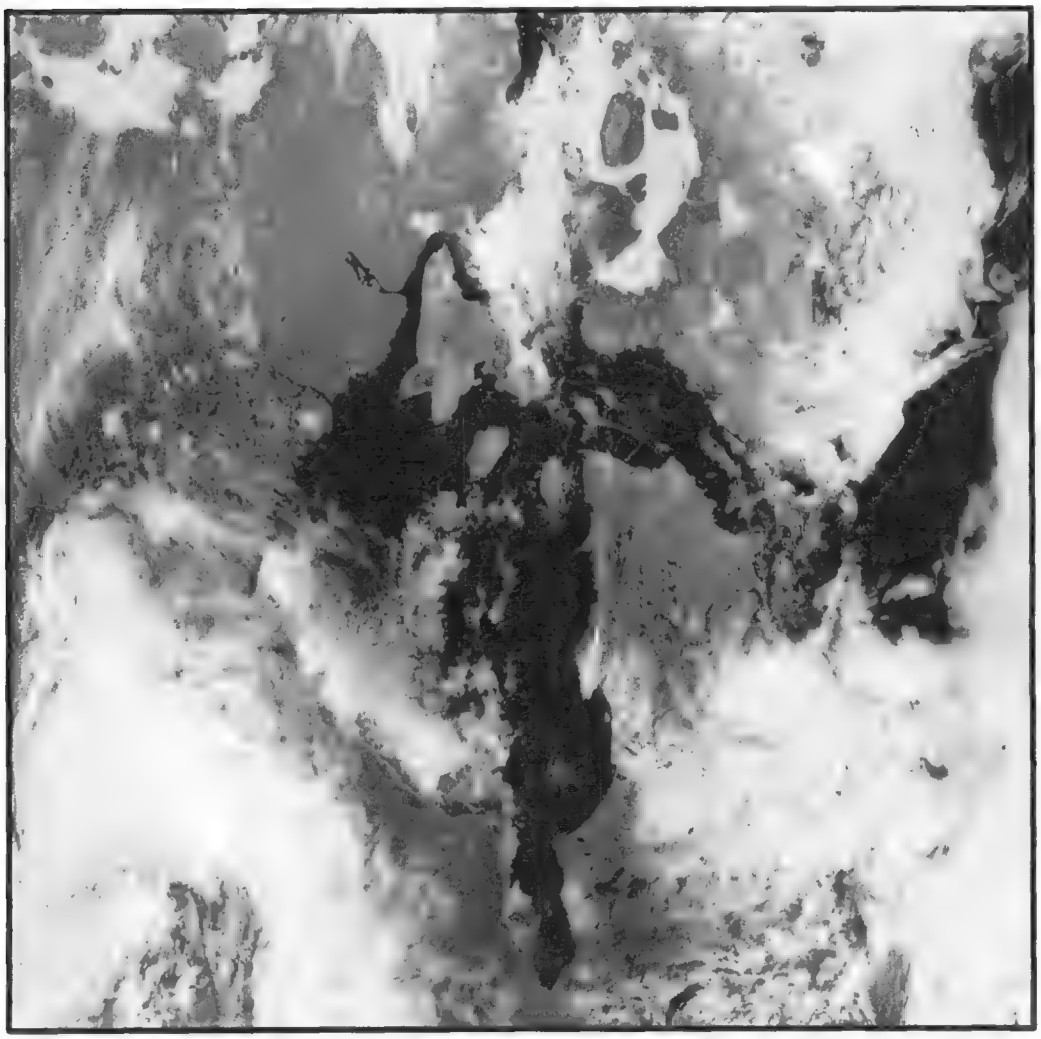

Figure 1 - Composite satellite imagery of prominent features in SAR Area 155 including Hudson Bay, Foxe Basin, Southampton Island, Flaherty Island, Melville Peninsula, and James Bay. (June 28, 2017)

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Annex B: Environmental Scan – Area 155

Executive Summary

Search and Rescue (SAR) Area 155 underwent a Search and Rescue Risk Analysis (SARRA) Study using the Risk-Based Analysis of Maritime SAR Delivery (RAMSARD) Methodology to study climate, geography, demographics, and human activity in the Arctic. The Environmental Scan is an important aspect of the risk analysis process and was designed to help evaluating risks to mariners in Search and Rescue Areas (SRA) on Coast Guard mandated waters. Environmental scans can help the Canadian Coast Guard (CCG) shape its resource management plans in response to rapids changes and create a vision of future requirement.

Summarized Findings

- James Bay is affected by storm surges up to 60cm during strong wind events.
- James Bay has the longest ice-free season. Followed by Hall Beach due to a large polynya.
- Vessels transiting the Northwest Passage use Fury and Hecla Strait, adjacent to Igloolik.
- Foxe Basin does not fully melt some years and is notorious for 2nd year ice drifting through shipping lanes late into the marine season.
- Merchant cargo vessels do not travel to communities with road access. Tug vessels & barges are used instead to deliver resources to nearby communities in James Bay.
- Small craft are known to transit up to 400 nautical miles between communities.
- Strong tides, fog, and ice floes make Hudson Strait hazardous for commercial vessels
- The Hudson Lowlands of Northern Ontario and Manitoba are an 800nm long lee shore with few safe natural harbours.

Figure 2 – SAR Area 155 Vessel Traffic

1. Map of SAR Area

1.1 Maps

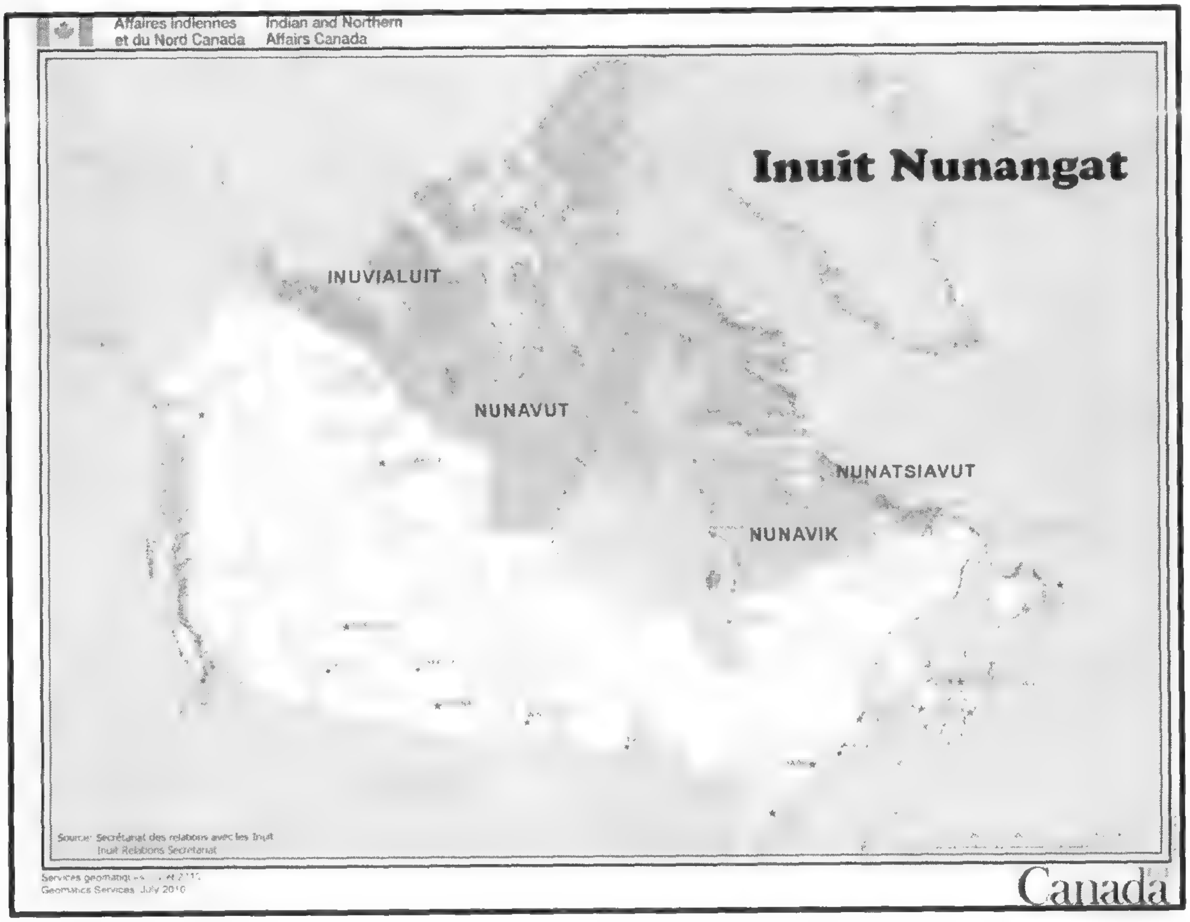


Figure 3 – Inuit Nunangat of Canada

Annex B: Environmental Scan – Area 155

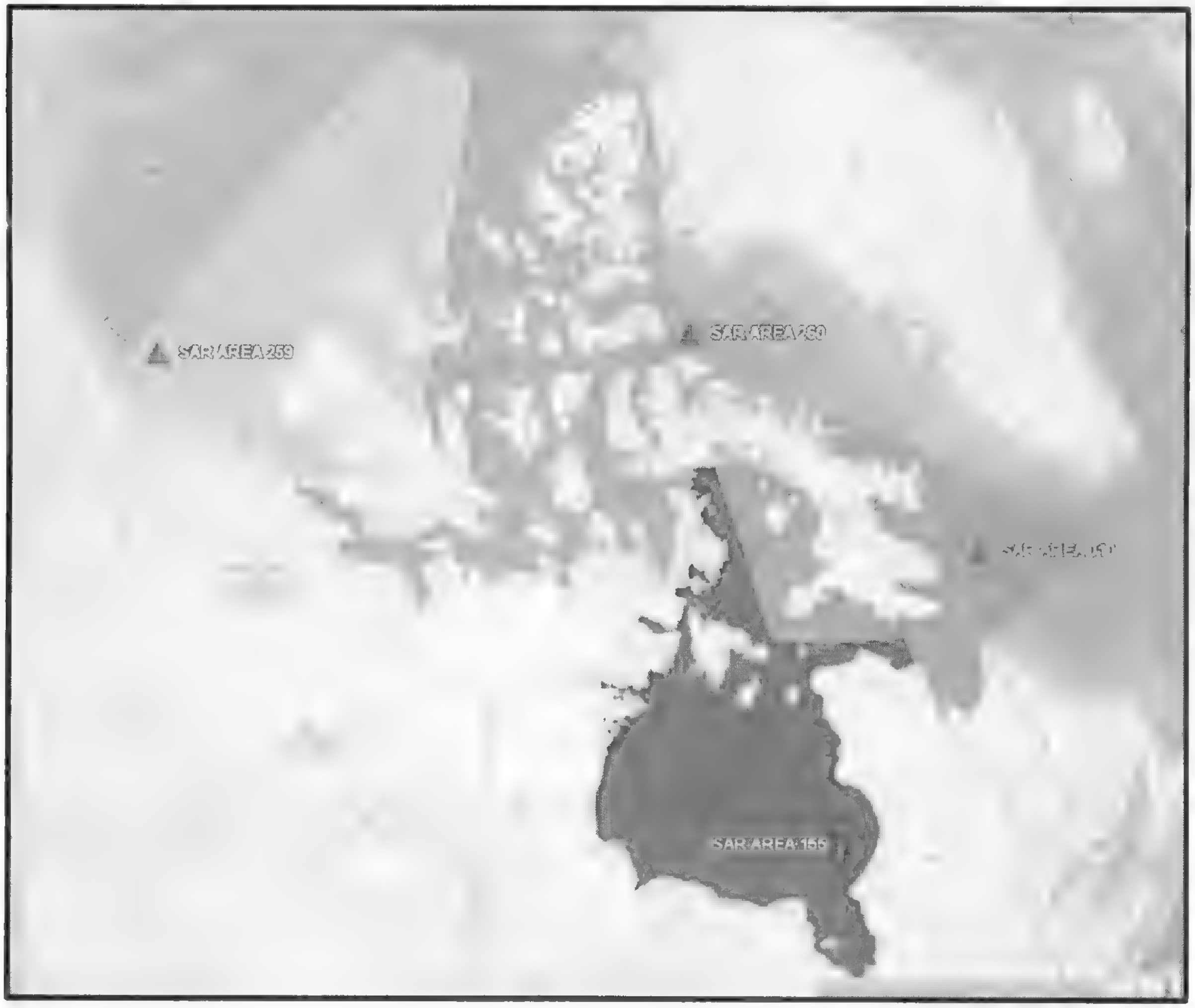


Figure 4 – RAMSARD defined regions of study. The Arctic includes 010, 155, 259, and 260. These are the boundaries for maritime SAR.

Figure 5 – Imagery of SAR Area 155

1.2 Description of Dimensions & Distances

SAR Area 155 encompasses Hudson Bay, James Bay, Davis Strait, and Foxe Basin. The area encompasses 1,230,000 km^2 (358,127 NM^2) of ocean. The area spans 1200NM (51°N to 70°N) latitude and 720NM (070°W to 094.5°W) longitude at its widest points.

Area 155 shares a marine border with 010 in Hudson Strait and Foxe Basin. SAR Area 155 is also connected to SAR Area 260 through the Fury and Hecla Strait, a body of water connecting Foxe Basin to the Gulf of Boothia.

2. Climatology & Oceanography

Numerous climate factors are significant to the SAR program. The examination of climate by season in each SAR Area are conducted using 30 year climate normals for climate parameters including: prevailing wind direction, mean seasonal and maximum wind speed, percentage frequency of wave height greater than 2.0 metres, mean air temperature, mean seasonal minimum sea surface temperature, percentage frequency of visibility less than 1 nautical mile, percentage of fog occurrence, mean seasonal maximum of current speed, mean seasonal sightings of icebergs, mean days per season of ice coverage with concentration greater than 7/10ths and thickness greater than 15 cm, presence of old ice and first-year ice.

After the presentation of the climate factors significant to the SAR program for each main area of SAR Area 155, a brief narrative about the effect on climate change on ice season, population, micro-climates, precipitation and winds are revealed. Finally, main findings for navigational risk in SAR Area 155 are presented.

For the purposes of this environmental scan, the seasons are defined[1] as:

- Winter – December, January, February
- Spring – March, April, May
- Summer – June, July, August
- Fall – September, October, November

[1] Climate of the Canadian Coast Guard SAR Areas, 2018.

2.1 Prevailing Wind Direction

Prevailing wind in SAR Area 155 is from the NW.[2]

During the winter months, winds are generally from the west to west-northwest, with the predominant wind being a 20-30 knot westerly wind. As spring approaches, the frequency of west to west-northwest winds decreases. Predominate wind speed is from a northwesterly direction with the most frequent wind speed being 10-20 knots from the northwest.

South to south-southwest winds become more predominate during the summer months with 6% of all wind speeds being from the south-southwest at 10-20 knots. By autumn, winds become more west to west-northwest once again with the 10-20 knot westerly wind being the most predominate.

2.1.1 Low Pressure Systems

Summer storms routinely track from the West and Southeast.[3] Storm tracks are represented by maps combining numerous sequential plots of low-pressure centers over time. These tracks tend to shift more Southward as the active marine season progresses. Storms are most prevalent in autumn and winter.

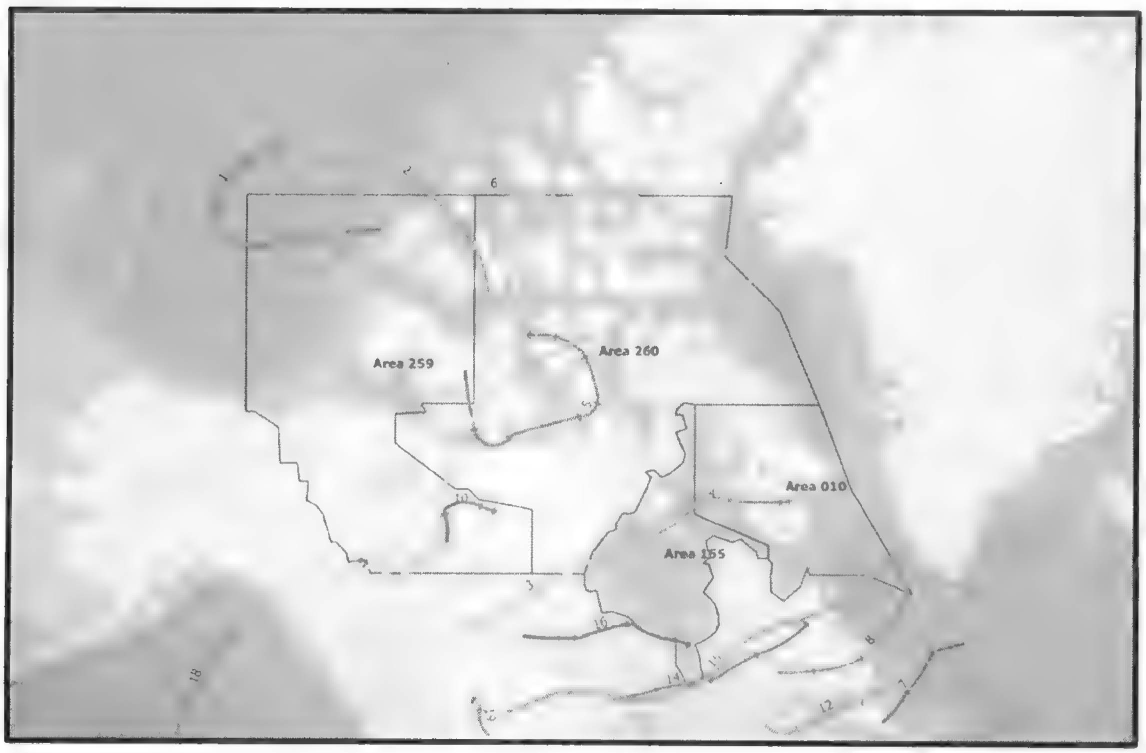


Figure 6 – The 20 Principle Storm Tracks for June, July and August (adapted from ECCC, 2017)

[2] Climate of the Canadian Coast Guard SAR Areas, 2018.
[3] Environment and Climate Change Canada, 2017.

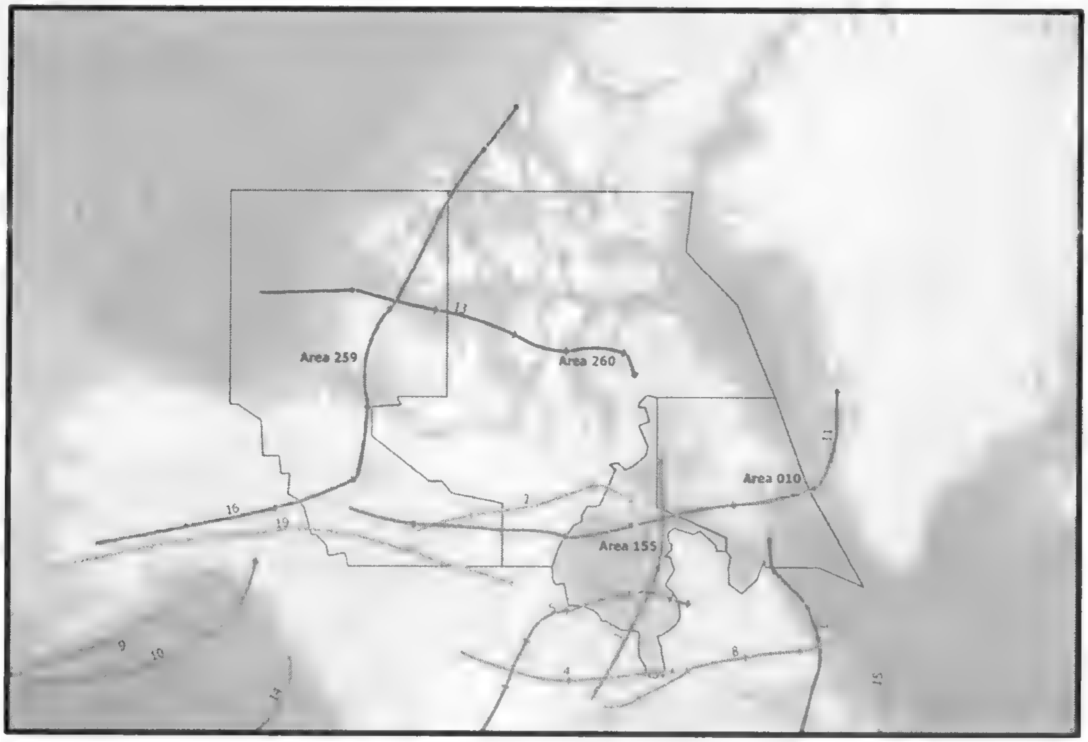


Figure 7 – The 20 Principle Storm Tracks for September, October and November (adapted from ECCC, 2017)

During the late summer and early fall, cool air and warm waters generate greater instability, causing the formation of convective clouds that can produce showers or flurries. Wind speeds also increase, rising noticeably by late September. Gales are most frequent over the bay from October to December, as the water begins to freeze, and least frequent from May to September.

Gale force winds are more frequent during the winter months. Wind speeds greater than 30 knots occur 4.5% of the time during the winter months, but only 0.1% of the time during the summer. Summer wind conditions are relatively light while the autumn boating season sees worsening conditions.

Table 1 – Mean Seasonal Wind Speed

Season	Mean	Mean Maximum
Winter	11.4	38.2
Spring	11.3	37.4
Summer	9.9	32.7
Autumn	12.1	40.4

2.1.2 Local Winds

This section will explore the impact of localized winds on the marine environment. While local wind effects are few, West-Northwest winds may be slightly stronger across the entrance to James Bay and Cape Henrietta Maria. Since larger vessels tend to travel through the deeper channels in the middle of the bay, these gusty offshore winds only affect coastal boat traffic.

Figure 8 – Local Winds and Weather

NAV Canada Meteorological Symbols	
Low Cloud Cover	
Prevailing Winds	
Funneled Winds	
Fog	
High precipitation	
Note: Remaining symbols depicted on maps are for aviation use and have not been included in the scope of this report.	

Figure 9 – Local winds and weather for Southern Nunavut. (NAV Canada)

2.1.3 West Hudson Bay

In the spring, low cloud and fog occur frequently. Easterly flows readily move this low cloud and fog inland. Prominent land features such as cliffs, islands, and mountains disperse cloud cover as they pass to leeward. Low-pressure systems are often deflected into the area from the South giving rain and fog events along the coast.

In the fall, low-pressure systems become more energetic as the air mass contrasts strengthen and open water surface area is at its maximum. Winds strengthen and can be very gusty from the Southeast ahead of the low and from the Northwest behind it.[4]

[4] NAV Canada, the Weather of Nunavut and the Arctic, 2001.

2.1.4 Foxe Basin

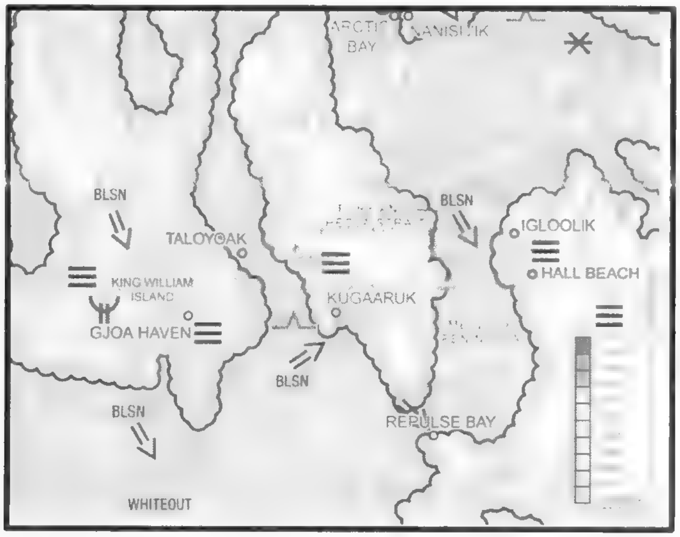


Figure 10 – Foxe Basin Local Winds and Weather

Igloolik and Hall Beach are situated adjacent to large polynyas in the winter months. These stretches of open water release heat energy from the ocean and give rise to local winds travelling in the direction of the open water. Polynyas form due to strong currents and prevailing winds. Ice near the edge of a polynya is thin enough to fall through.

In the fall, onshore flow from open water areas brings 'sea smoke' or freezing fog.

2.1.5 Ungava Peninsula

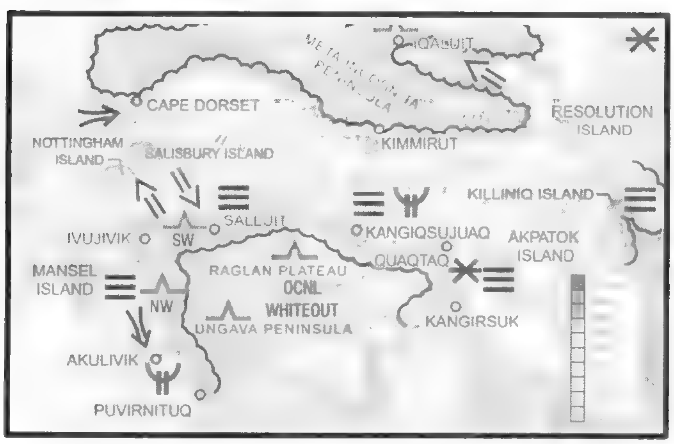


Figure 11 – Ungava Peninsula Winds and Weather

Fog is widespread in the Ungava peninsula for the communities of Kangiqsujuaq, Salluit, Ivujivik, Akulivik, and Puvirnituq. Wind funnels along the coast towards Akulivik. Local winds near Ivujivik and Salluit oppose one another, creating confused seas.

2.1.6 South Hudson Bay

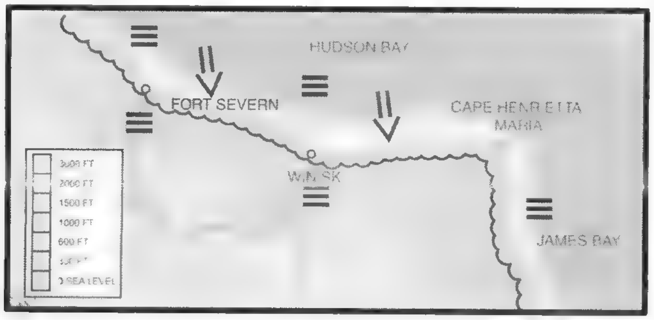


Figure 12 – South Hudson Bay Wind and Weather

Peawanuck (formerly: Winisk) and Fort Severn experience frequent fog during the boating season. Prevailing wind is from the North.

2.1.7 James Bay

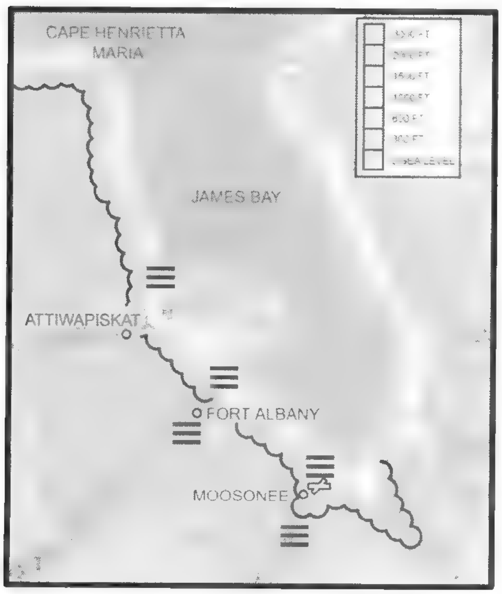


Figure 13 – James Bay Wind and Weather

Fog is common. Local winds align with the regional prevailing direction, NW.

2.1.8 Southwest Hudson Bay

Churchill experiences frequent fog. Prevailing wind is West-Northwest.

Figure 14 – Southwest Hudson Bay Wind and Weather

2.2 Waves

Median wave heights in August and September are 1-2 m with periods of 5-6 seconds. North and South flows have the largest fetch, and thus generate the biggest waves. Northwest flows cause large swells at the entrance to James Bay and communities along the Eastern coast of the bay. Communities along the windward shore of Foxe peninsula and Hudson Bay experience swell from occasional S to SE winds from passing storms. All communities experience varying degrees of on-shore winds during the summer as cool air over the ocean travels inland to replace rising air over warmer land.

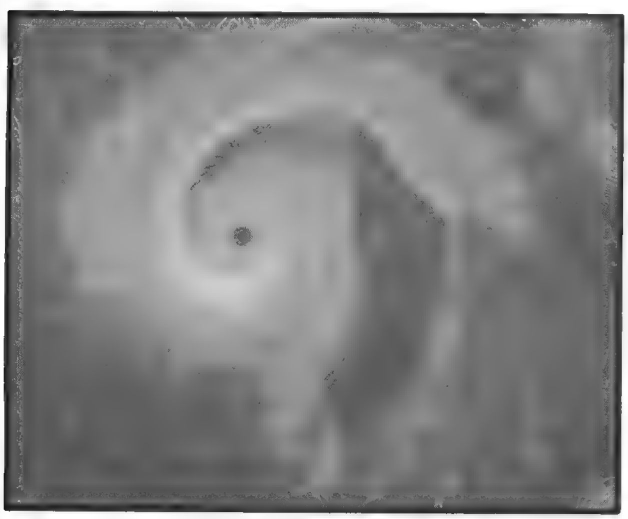


Figure 15 - On August 11, 2016 a powerful low pressure system created 50-70km/h winds for a period of 24 hours. Maximum wave height is estimated at 5.3m

Table 2 - Significant Wave Height

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	36.1	12.5
Spring	13.7	5.5
Summer	5.1	0
Autumn	15.5	3

2.3 Temperatures

2.3.1 Seasonal Air Temperature (°C)

Air temperature in Area 155 is closely linked with the albedo effect of snowpack & ice, daylight hours, continental weather, and sea surface temperature. The climate is equal parts tundra and subarctic according to the Köppen–Geiger climate classification system. The Moosonee River valley loosely qualifies as a warm-summer humid continental. Subpolar regions experience at least one month of mean temperatures above 10°C. Tundra regions are classified as having mean monthly temperatures rise above 0°C for part of the year without exceeding 10°C.

Climate around Hudson Bay is consistent with weather systems moving from West to East. The windward side of the bay receives warm continental air while the lee (East) shore experiences cooler temperatures due to the cold water lowering air temperature.

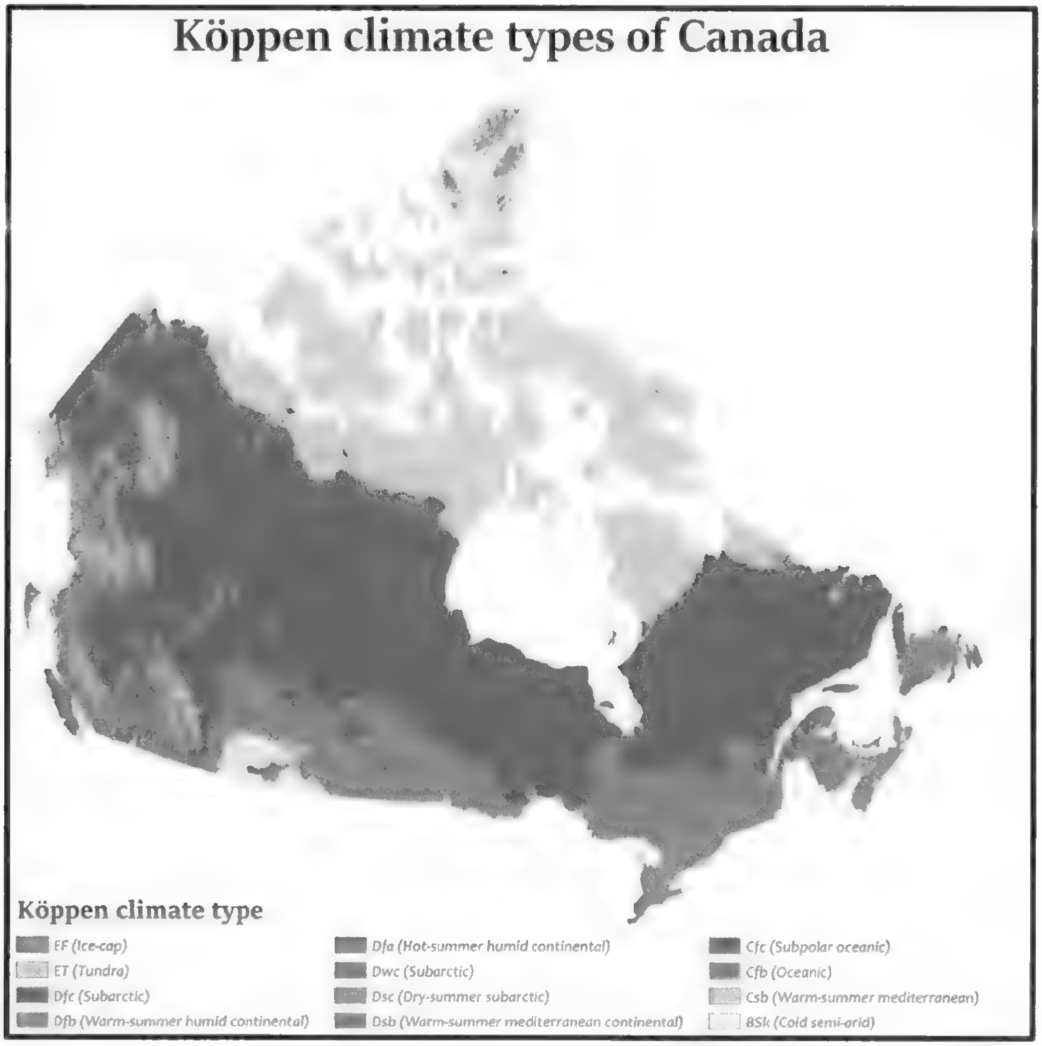


Figure 16 – Climate Types of Canada

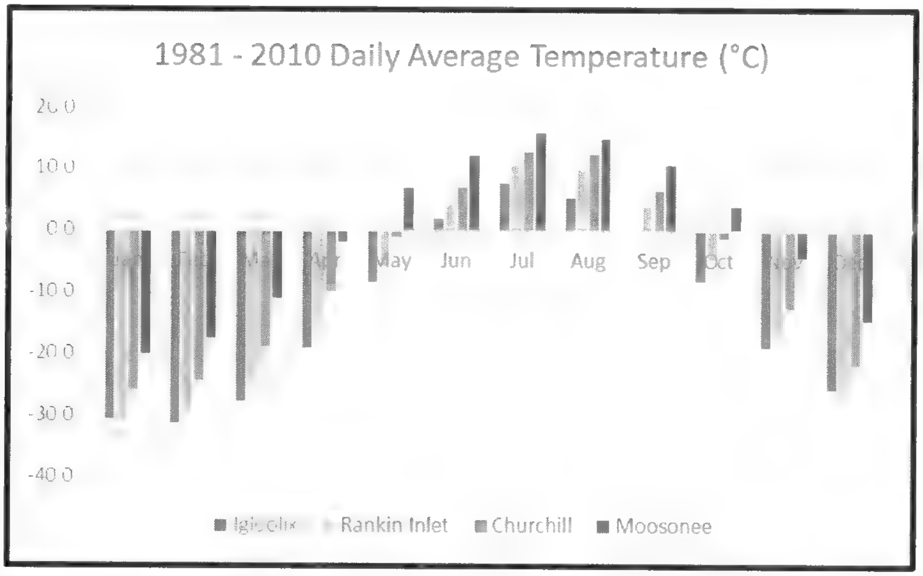


Figure 17 – 30 Year Climate Normals for 4 Communities Along the Shore of SAR Area 155

Figure 18 – Sample Communities Used for Temperature Data

The seasonal variation of sea-surface temperatures in the Hudson and James Bay during the active marine season shows a significant gradient in the South and little variation in the North as these waterways are ice-free for a shorter period of the year.[5]

2.3.2 Seasonal Sea Surface Temperatures (°C)

Table 3 – SST for Hudson Bay

Season	Minimum	Maximum
Winter	-1.4	0.1
Spring	NA	NA
Summer	-1.3	13.8
Autumn	-1.9	12.7

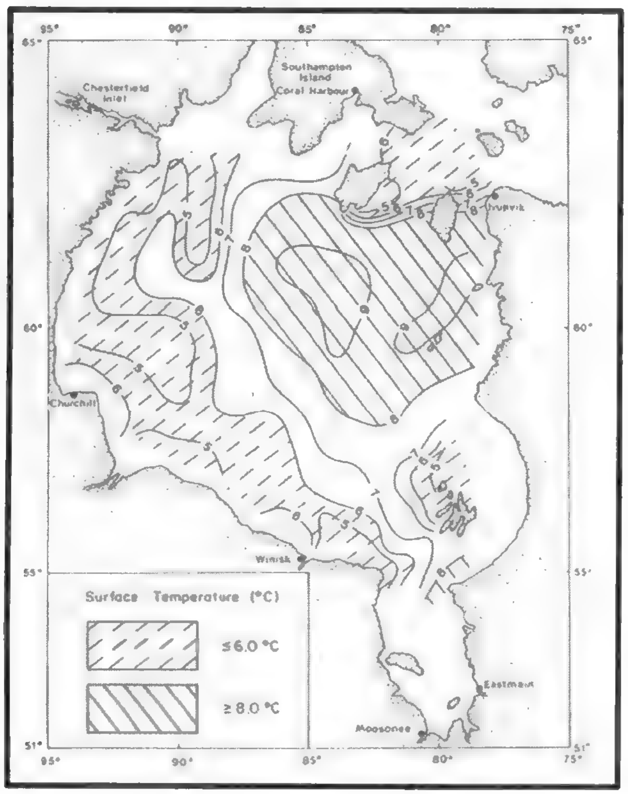


Figure 19 – Sea Surface Temperatures from August-September (1975)

[5] Environment Canada, Canadian Climate Normals, 2010.

2.4 Sea Ice

During a single winter in the Arctic, maximum ice thickness is about 200 cm. Second year ice in Foxe Basin reaches a thickness of 300 to 450 cm. In James Bay, first year ice forms to 120 cm thickness.[6]

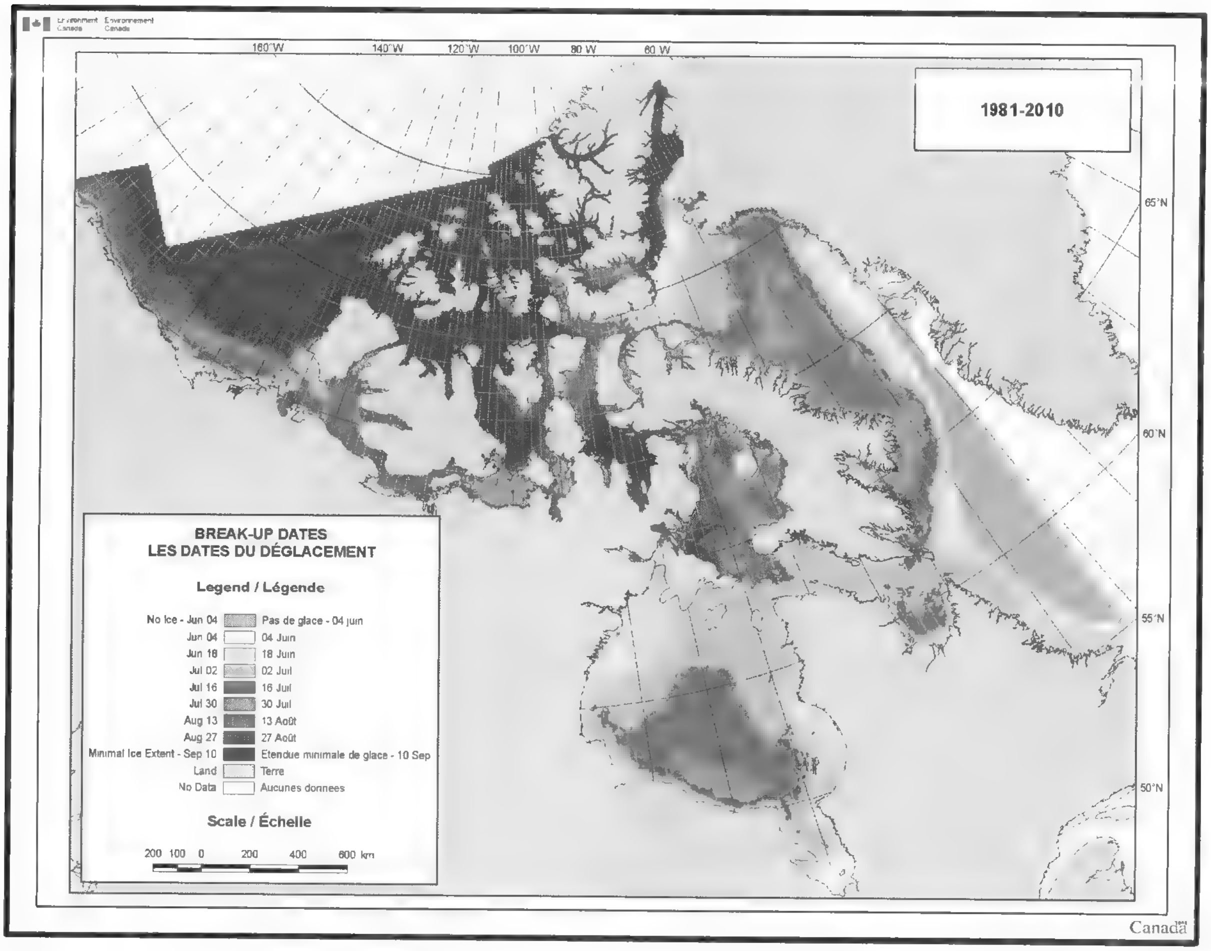


Figure 20 – Ice break up dates. A combination of sun and ocean current work to remove ice in the boating season.

[6] Canadian Ice Service

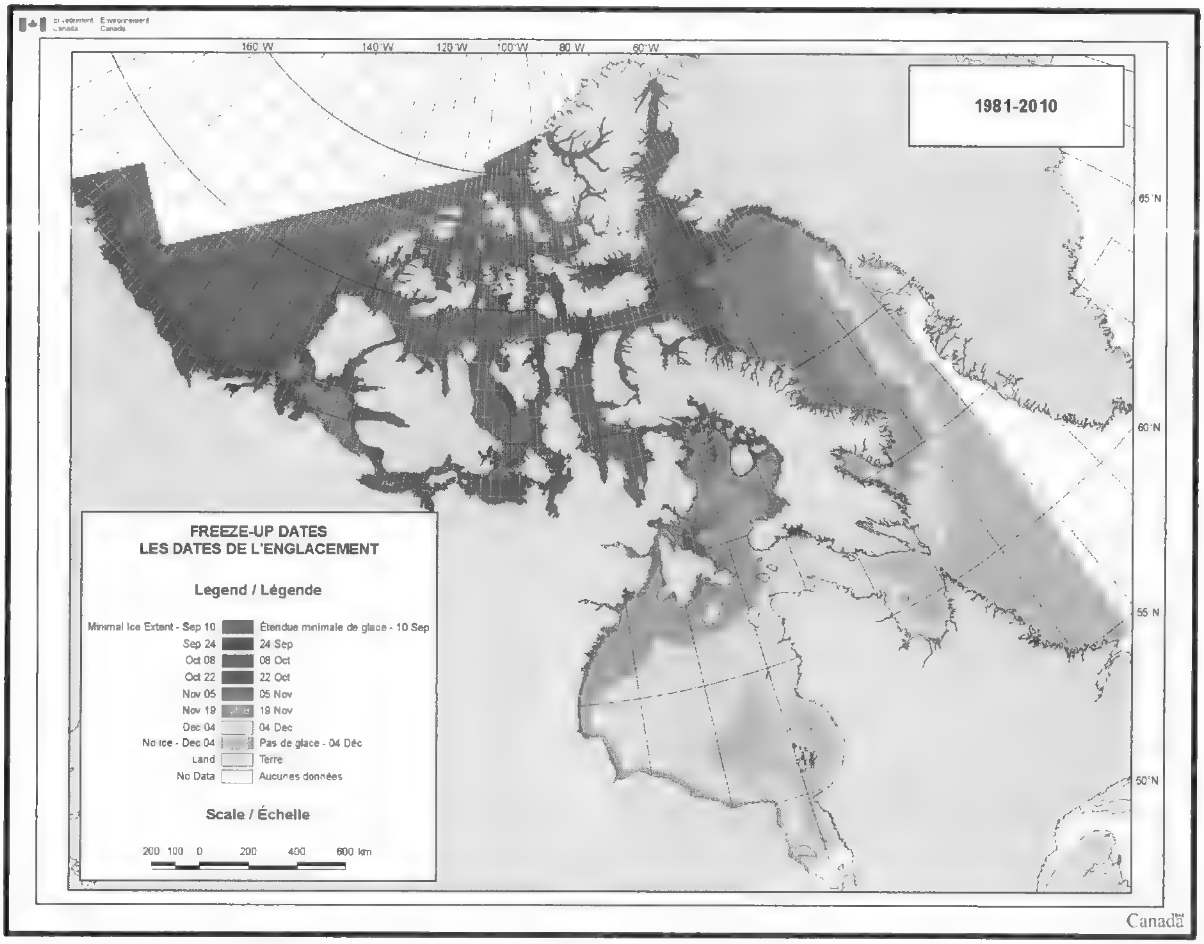


Figure 21 – Shore fast ice is the first sign of winter.

2.4.1 James Bay

Ice normally forms in the Western portion near mid-November and on the Eastern shore by December, thickening rapidly and spreading seaward to cover James Bay. There's usually no ice surrounding North and South Twin by December 4th. No data is available for Charlton Island and surrounding islands. The ice becomes predominantly medium thickness first-year ice by the end of December.

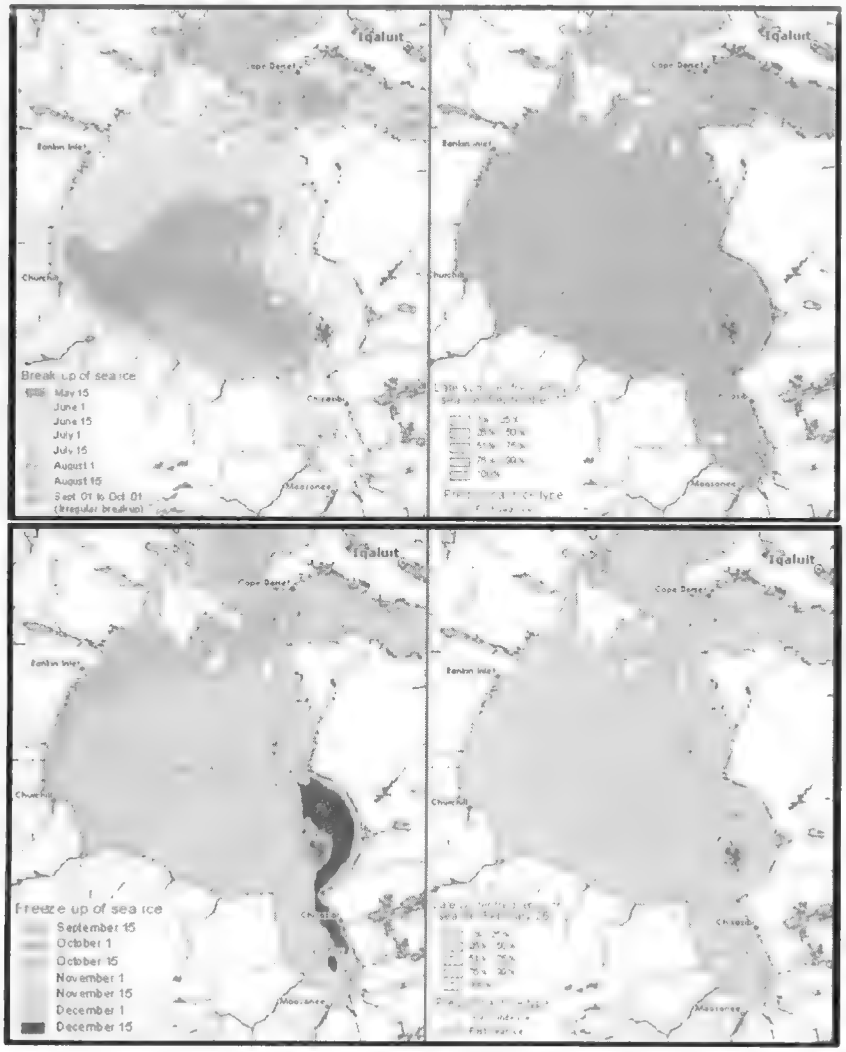


Figure 22 – Ice Conditions in Hudson Bay

Break-up in James Bay starts near the end of April and gradually spreads Northward during May and June. South winds expedite the process by pushing ice out of the bay. Strong North winds can be helpful, too, as after a storm surge, ice is carried out to sea. In early September James Bay is typically completely clear of sea ice.

2.4.2 Hudson Strait

Freeze-up usually begins near the shore in western Hudson strait in November, then ice formation progresses to cover the entire area by early December, and by mid-December the first-year stage predominates. Except for quite extensive shore-fast ice among the islands from Big Island to Cape Dorset, the ice is in constant motion because of strong currents and frequent gale force winds. Ridging, rafting and hummocking are continually taking place. At times small concentrations of second year ice drift into the area from Foxe Basin.

Open water leads develop in May and slowly expand in June. Clearing becomes extensive during the first week of July. Complete clearing has taken place as early as mid-July and as late as the end of August. It is worth noting that incursions of second year ice from Foxe Channel occur in some years. In Hudson Strait, freeze-up has started as early as mid-October and as late as the first week of December.

2.4.3 Foxe Basin

Ice normally forms in Northern and Western portions near mid-October, thickening rapidly and spreading Southward and seaward to cover the Basin and Foxe Channel early in November. The ice becomes predominantly first-year ice by December.

Melting starts by June. The polynyas near Hall Beach and Igloolik slowly enlarge. Open water leads expand around the shoreline in July. In the central Basin, the ice very gradually decreases in amount but more rapid disintegration occurs in August. Patches of ice persist during September.

In Northern and Southwestern sectors there are large areas of shore-fast ice. In some years, all the ice will melt throughout Foxe Basin and Foxe Channel, while in other years with a cold summer, significant concentrations of ice will remain as freeze-up begins again. Thus second year ice may affect Foxe Basin and adjacent waters through the following winter and spring.

In Foxe Basin, freeze-up has started as early as late September and as late as the third week of October. Complete clearing does not occur every year but has occurred as early as the first week of September.

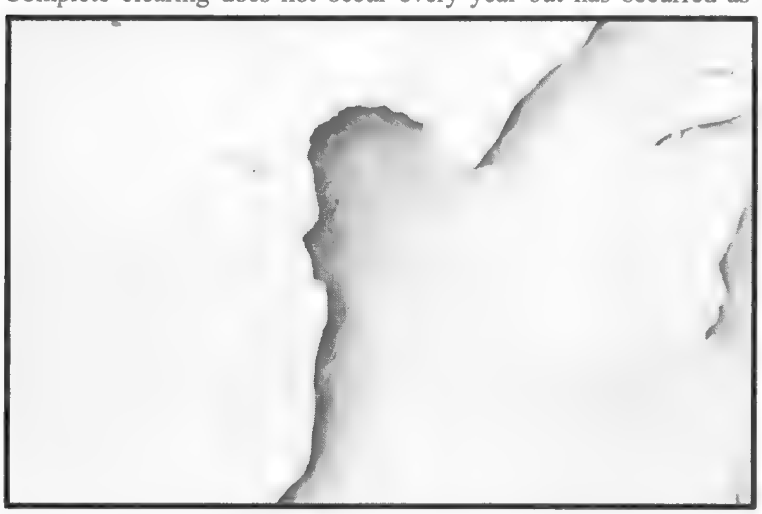


Figure 23 - Foxe Basin Polynya (April 22, 2018)

2.5 Tide & Current

2.5.1 Ocean Current

Ocean currents in Area 155 are moderate to light. South flowing water in Foxe Basin near Hall Beach and Igloolik create polynyas at the narrows of Fury and Hecla Strait, Jens Munk Island, and the off the coast of the two communities, the latter being significantly larger.[7]

The currents in Hudson Strait are strong, with progress more rapid along its Southern shore. The strongest currents occur around the end of the Quaqtaq Peninsula – just to the East outside Area 155. Combined with extreme tidal variation, the North shore of Ungava Peninsula is hazardous to small craft and commercial shipping alike. Safer passage exists offshore, where the effects of tidal surges are dampened.

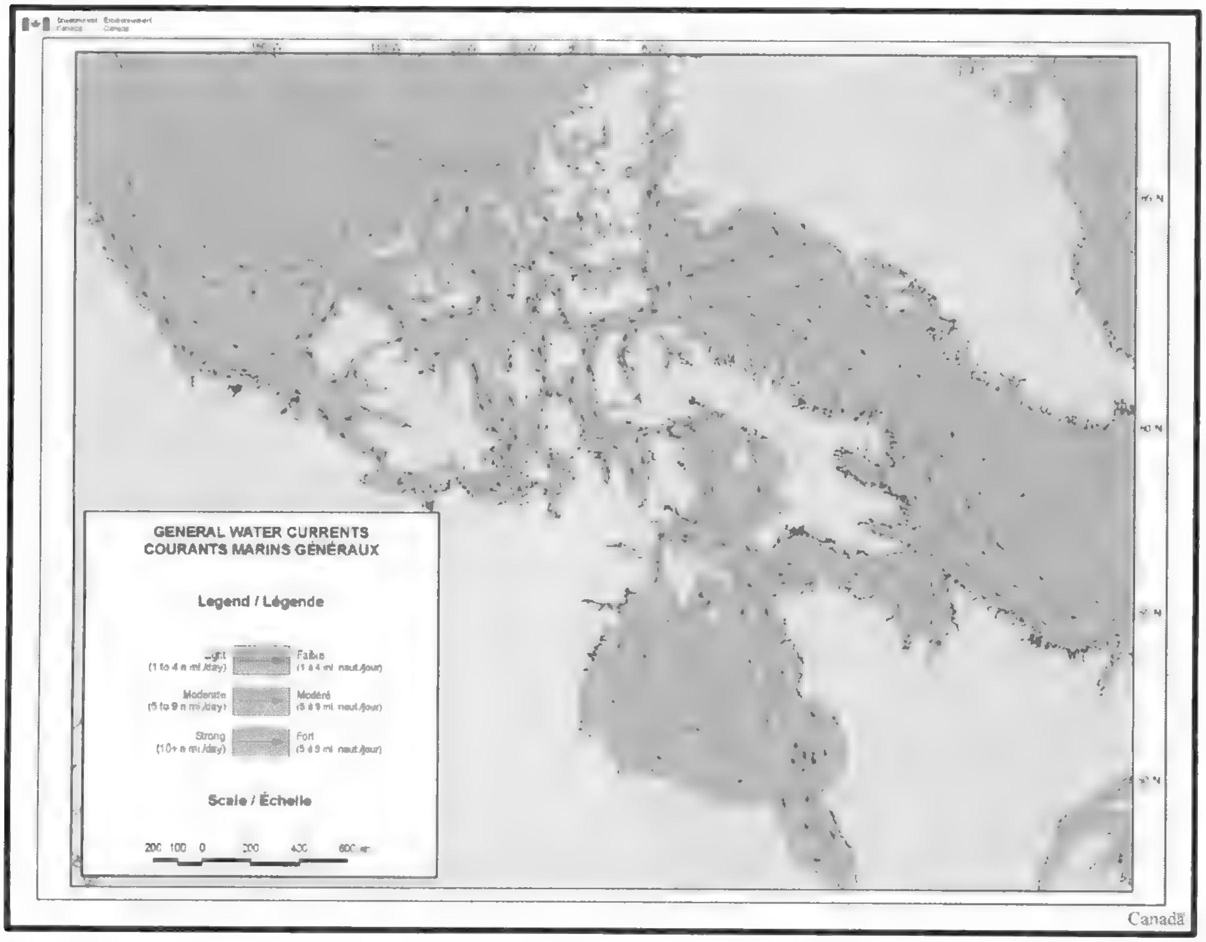


Figure 24 – Hudson Bay rotates in a counter-clockwise gyre while Foxe Basin has moderate, South-moving currents which later enter the Hudson Strait.

[7] Environment Canada

2.5.2 River Output

Of note is the introduced fluctuation of fluvial output in James Bay and Northwestern Quebec as a result of hydroelectric dam construction in the area. In 1971, Hydro-Quebec initiated the James Bay Project and began to construct dams along La Grande River (with Eastmain, Rupert, and Caniapiscau rivers diverted into La Grande). Additional river diversions doubled the watershed size from 97,400km^2 to 206,430km^2.

Eastmain and Waskaganish are situated at the mouths of re-directed rivers. These communities experience reduced river polynya in the winter. Conversely, Chisasibi is located next to La Grande River where increased demand for electricity in the winter causes the river to release up to 10 times the typical seasonal amount. Shoreline erosion is common as the river re-defines its estuary. Additionally, winter polynya near the mouth of the river will be larger, and last longer than is expected for the climate of Chisasibi.

2.5.3 Tides

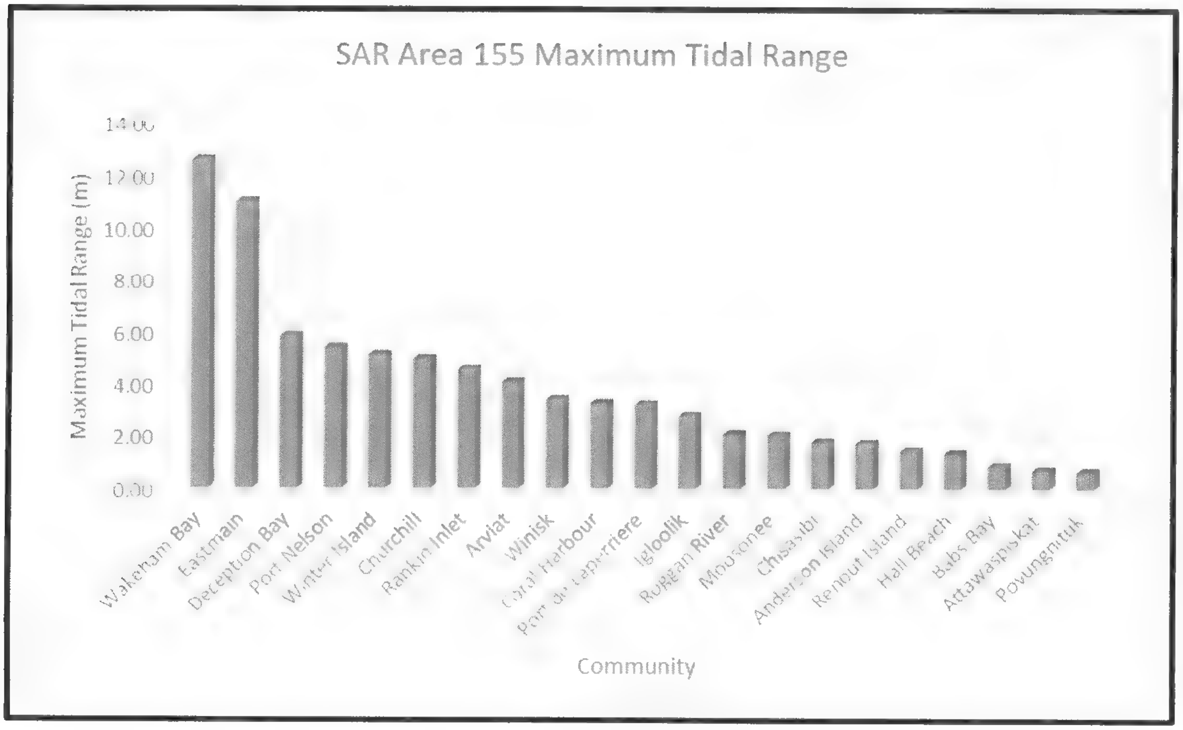


Figure 25 – SAR Area 155 Maximum Tidal Range

Table 4 – Tides in SAR Area 155

SAR Area 155 Tidal Range

Region	Community	Max Tide Range (m)
Foxe Basin	Igloolik	2.78
	Hall Beach	1.35
	Winter Island	5.09
James Bay	Attawaspiskat	0.70
	Moosonee	2.02
	Eastmain	10.94
	Chisasibi	1.77
	Roggan River	2.07
Hudson Strait	Port de Laperriere	3.21
	Deception Bay	5.81
	Wakeham Bay	12.52
Hudson Bay	Coral Harbour	3.26
	Rankin Inlet	4.54
	Arviat	4.07
	Churchill	4.93
	Port Nelson	5.37
	Winisk	3.41
	Renouf Island	1.43
	Anderson Island	1.72
	Povungnituk	0.65
	Babs Bay	0.86

2.5.4 Storm Surge

Storm surges are known to occur in James Bay during the early spring (April to June) or late fall (September to December). They pose a hazard to travellers who may be unaware of water levels and current velocity as a result of combined surge and tidal activity. Conversely, strong or prolonged south winds can lower the water level in the Southern part of James Bay up to 0.6m.

A study by K.B Yuen and T.S Murty from the University of Ottawa shows a topographic representation of water level in Hudson and James Bay during a wind storm. Contours are 20cm.

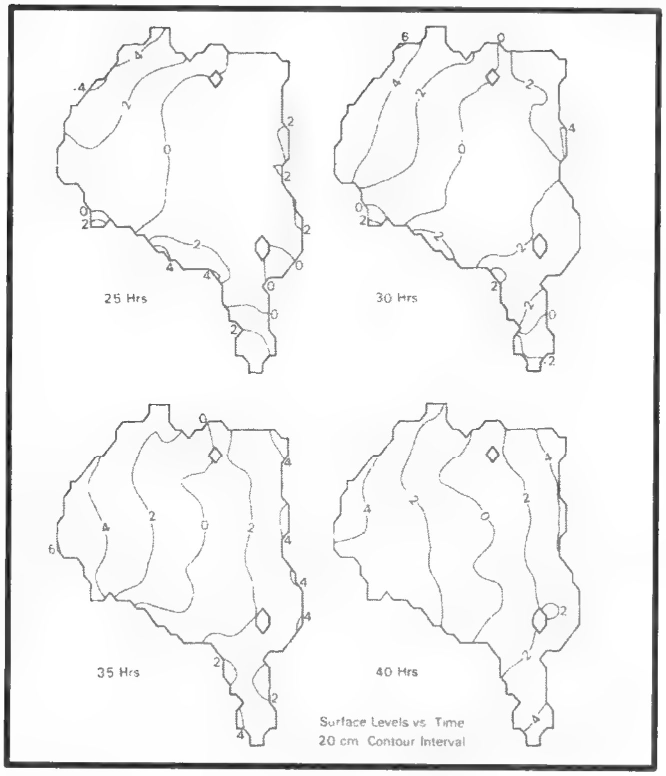


Figure 26 – Storm Surges in Hudson Bay

3. Maritime Geography

3.1 Coastal Features

3.1.1 Southwest Hudson Bay

This coast is characterized by Hudson Bay Lowlands. Gently sloping topography of the Hudson basin becomes several kilometers of marsh lands before the shore of Hudson Bay emerges. Hundreds of small creeks terminate along the shore in an approximately uniform distance from one another. Mud flats extend up to 9km into the bay. The Winisk, Severn, Nelson, and Churchill River flow northeast to sea and bring fluvial sediment as well as navigable routes extending inward from Hudson Bay.

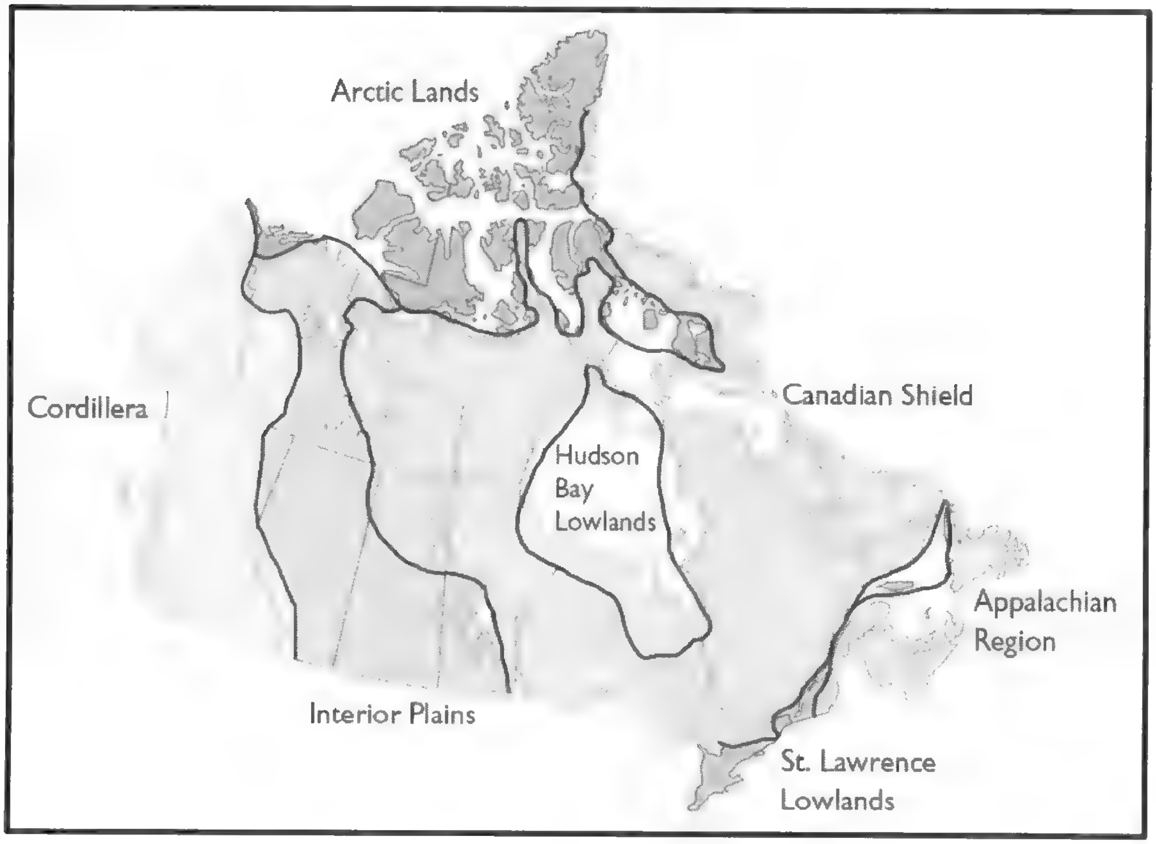


Figure 27 – Hudson Bay Topography

Figure 28 – Southwest Hudson Bay

3.1.2 Nastapoka Arc

The Nastapoka arc is a 200km long semicircular bight in the Southeast coastline. The Belcher Islands are slightly Southeast of the centre of the bight's radius. Geologically part of the Canadian Shield, the origin of this topographic phenomenon is debated. It is characterized by a gently sloping bathymetry Westward. Scattered barrier islands protect mainland Quebec Cree and Inuit communities from the worst of storms arriving from the West. The arc's broad shores mitigate strong tides.

Figure 29 – Nastapoka Arc

3.1.3 James Bay

The Western side of James Bay is part of the Hudson Bay Lowlands while the Eastern portion is comprised of Canadian Shield. This is discernable by noting the different shoreline profiles for each side of the bay. The lowlands side has wide, exposed shores with river deltas providing safe haven. The Eastern shore has numerous bays and rocky coves suitable for vessels with a draught of less than 3.7 m.

Akimiski Island is a large uninhabited island on the East side of the bay. The sheltered Akimiski Strait to the South has the earliest ice break up date in all of Area 155. Noticeable Islands across Chisasibi is the North Twin Island and across Wemindji is the South Twin Island. The largest Eastern island is the Charlton Island which is across Eastmain. The area, especially larger islands, features low-lying and often marshy land. Kilometer long mudflats extend from the mainland. Combined with tides and storm surges, land can be inaccessible for small craft due to deep mud on shore. Stratified sand and gravel (eskers), accumulation of glacial debris (moraine) and raised beach are common throughout the region.

Figure 30 – James Bay

3.1.4 Northeast Hudson Bay & Strait

Southampton, Coats, Mansel, and Nottingham Island populate the Area 155 side of Hudson Strait (the remainder of the area falls under SAR Area 010). The channel between Nottingham Island and Ungava Peninsula leads directly into Hudson Strait. It is the most used sea area for merchant cargo vessels transiting to western shore communities. This portion of the strait is 400m deep. A 10m flashing white light sits on shore of Digges Islet, it is visible from a distance of 10nm. The Nottingham light is flashing white with a period of six seconds and a range of 7nm.

The Ungava coast provides little shelter between Sugluk Inlet and Kovik Bay. The shore is comprised of steep cliffs, unsheltered inlets, and mountainous features. Mansel Island has an uninhabited natural harbour on its East coast. Coral Harbour sits on the windward shore of South Bay where a few nearshore rock hazards quickly give way to a uniformly sloping bathymetry of 20m depth.

Figure 31 – Northeast Hudson Bay

3.1.5 West Hudson Bay

Figure 32 – West Hudson Bay

Arviat, Whale Cove, Rankin Inlet, and Chesterfield inlet share similarities such as, rocky shorelines. The Canadian Shield has thousands of small islands and shoals along the Hudson Bay West shore. The result is a shore with an abundance of safe havens and excellent depth. Conversely, such geology has countless unmarked, uncharted, and unwavering shoals, underwater obstructions, and unintuitive bathymetry.

A 20m deep shelf extends 10nm offshore. Small islands and shoals are common in this bank. The sea bathymetry becomes uniform as the depth drops off beyond the bank to 100m and beyond.

3.1.6 West Foxe Basin

Figure 33 – West Foxe Basin

Arviat, Whale Cove, Rankin Inlet, and Chesterfield inlet share similar, rocky shorelines. The Canadian Shield has thousands of small islands and shoals along the Hudson Bay West shore. The result is a shore with an abundance of safe havens and excellent depth. Conversely, such geology has countless unmarked, uncharted, and unwavering shoals, underwater obstructions, and unintuitive bathymetry.

A 20m deep shelf extends 10nm offshore. Small islands and shoals are common. The sea bathymetry becomes uniform as the depth drops off beyond the bank to 100m and beyond.

3.2 Oceanographic Features

The median depth of Hudson Bay is 100m. It reaches to 270m at its deepest point. This is notably shallow given the size of this body of water. A bank of 20m depth exists around the perimeter of Hudson Bay, extending 10nm seaward. James Bay's deepest point is 50m. The area is summarized into three different geological regions: Canadian Shield, Hudson Bay Lowlands, and the Nastapoka Arc. Shield topography creates steep-sloping bathymetry and scatters islands throughout near-shore banks.

The lowlands of Ontario, Manitoba, and Nunavut (Southampton Island) create gently sloping ocean bottom due to erosion characteristics of these muddy and sandy areas. The Nastapoka Arc is part of the Canadian Shield, however it differs in substantial ways. No shore bank exists for the Arc, the depth drops off almost immediately to 100m, before rising again in most places to form a uniform length of offshore islands less than 5nm away. On the seaward side of these barrier islands, depth once again drops immediately to approximately 100m into Nastapoka Sound.

Figure 34 – ArcGIS Map of Hudson Bay

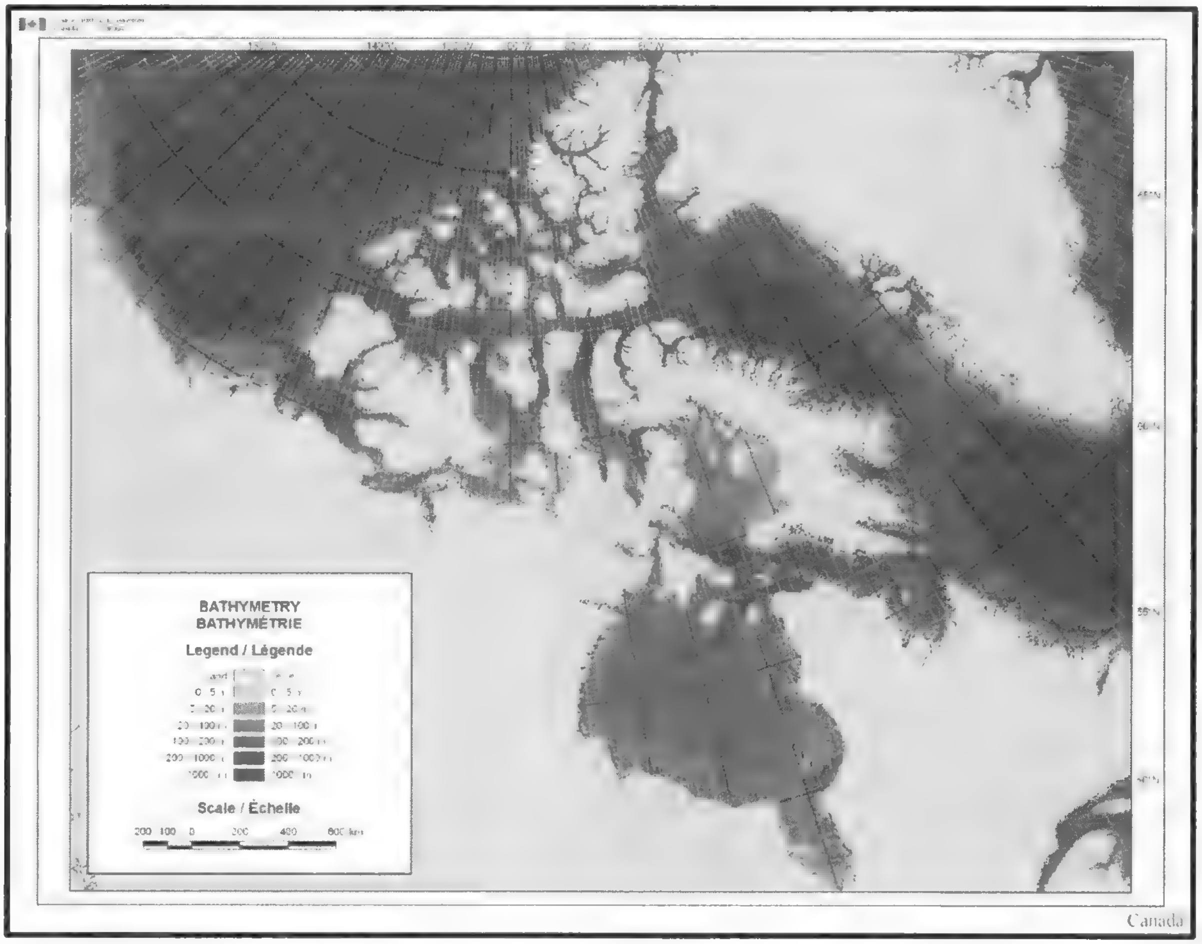
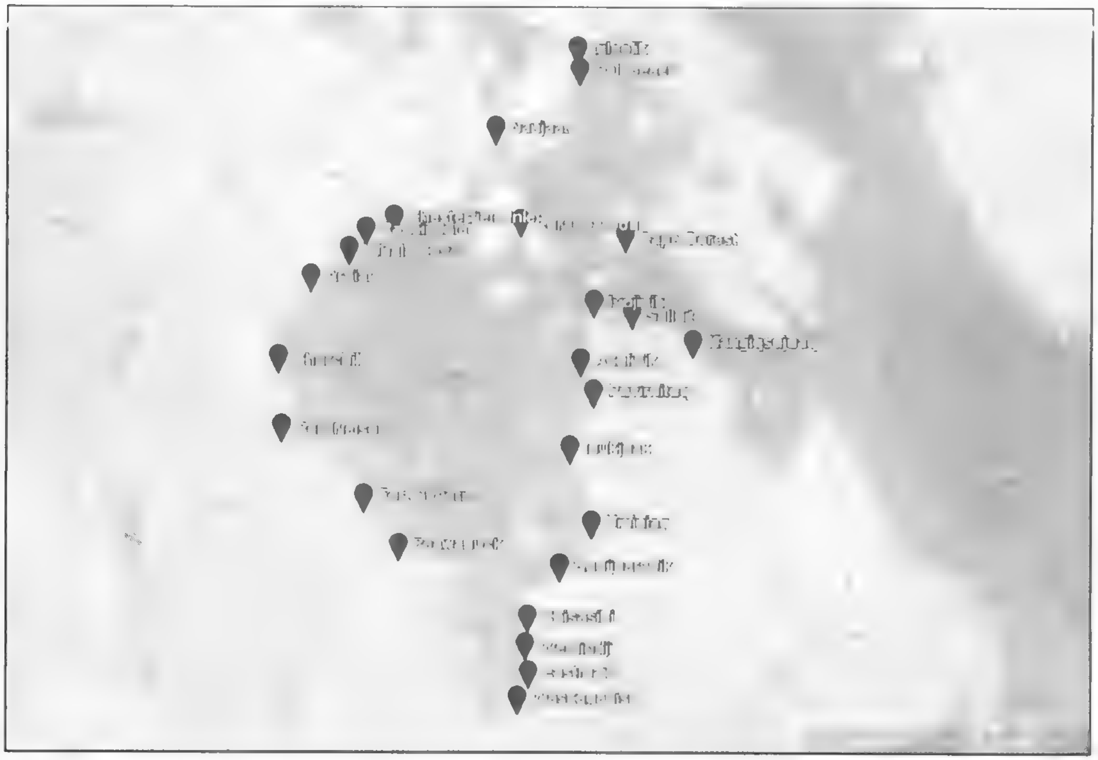


Figure 35 – Bathymetry of the Canadian Arctic

4. Demographics

4.1 Coastal Population Centres

SAR Area 155 is a mix of Inuit and Cree communities. The population of the region under study is approximately 30,000.



Figures 36 – SAR Area 155 Communities

4.1.1 Deception Bay/ Purtuniq

Table 5 – Deception Bay Demographics

Population	0 (company town)[8]
Location	Latitude: 61° 49' 1.1" (61.817°) North Longitude: 73° 57' 1.8" (73.9505°) West Elevation: 316 meters (1037 feet)[9]
Description	Deception bay is the main point of entry for commercial shipping to and from the Raglan mine, located 100km South. The mine extracts 1.1 million tons of nickel each year which is then transported by vessel. The mine employs 950 people who arrive by road and air.

Figure 37 – Barge in Deception Bay

Figure 38 – Deception Bay

[8] Population information from Census 2016.
[9] Latitude and Longitude information from Mapcarta online software.

4.1.2 Salluit

Table 6 – Salluit Demographics

Population	1483
Location	Latitude: 62° 12' 14.8" (62.2041°) North Longitude: 75° 38' 36.4" (75.6434°) West Elevation: 35 metres (115 feet)
Description	Salluit stands at the far end of the narrow Sugluk Inlet, 10 km inland from the Hudson Strait, hidden between high, rugged mountains rising close to 500 m. Salluit being the middle point between Nunavik's 14 communities, it is a strategic location for meetings attended by people of the Hudson and Ungava coasts.

Figure 39 – Salluit

Figure 40 – Sugluk Inlet

4.1.3 Ivujivik

Table 7 – Ivujivik Demographics

Population	414
Location	Latitude: 62° 25' 2.5" (62.4174°) North Longitude: 77° 54' 57.3" (77.9159°) West Elevation: 1 metere (3 feet)
Description	Roughly 2000 km North of Montreal, Ivujivik is Quebec's Northernmost village. Nestled in a small, sandy cove, the village is surrounded by imposing cliffs that plunge into the tormented waters of Digges Sound. This is the place where the strong currents of Hudson Bay and the Hudson Strait clash.

Figure 41 – Ivujivik

Figure 42 – Ivujivik

4.1.4 Puvirnituq

Table 8 – Puvirnituq Demographics

Population	1779
Location	Latitude: 60° 2' 8.4" (60.0357°) North Longitude: 77° 16' 26.6" (77.2741°) West Elevation: 1 metre (3 feet)
Description	Located 4 km from Povungnituk Bay, on the North shore of the major river by the same name, this Inuit village is surrounded by an expansive plateau. It is a mixture of countless lakes and rivers, rich wildlife and precious arctic plants and flowers. Puvirnituq also witnesses every year the migration of the Leaf River caribou herd. For several days every fall, thousands of caribou, their hooves pounding the frozen tundra, arrive and plunge across the Povungnituk River in a spectacular display.

Figure 43 – Puvirnituq

Figure 44 – Puvirnituq

4.1.5 Akulivik

Table 9 – Akulivik Demographics

Population	633
Location	Latitude: 60° 48' 2" (60.8006°) North Longitude: 78° 11' 57.7" (78.1994°) West Elevation: 1 metre (3 feet)
Description	Akulivik takes its name from surrounding geography. A peninsula jutting into Hudson Bay between two small bodies of water, the area evokes the shape of a kakivak, a traditional, trident-shaped spear used for fishing. To the South is the mouth of the Illukotat River and to the North is a deep bay which forms a natural port and protects the village against strong winds.

Figure 45 – Akulivik

4.1.6 Inukjuak

Table 10 – Inukjuak Demographics

Population	1757
Location	Latitude: 58° 27' 16.8" (58.4547°) North Longitude: 78° 6' 5" (78.1014°) West Elevation: 6 metres (20 feet)
Description	Inukjuak is located on the north bank of the Innuksuak River, known for its turquoise water and turbulent rapids. The many archaeological sites scattered along the meandering river evidence thousands of years of inhabitation. The land around Inukjuak is marked by gently rolling hills and open spaces which endow the landscape with a "silent beauty," in the words of local Inuit.

Figure 46 – Inukjuak

4.1.7 Umiujaq

Table 11 – Umiujaq Demographics

Population	442
Location	Latitude: 56° 33' 11" (56.5531°) North Longitude: 76° 32' 58.1" (76.5495°) West Elevation: 19 metres (62 feet)
Description	It is at the foot of a hill resembling an overturned umiaq (traditional Inuit walrus-skin boat) that Umiujaq was established. The landscape around the village is splendid and varied. Exploration is particularly enjoyable by foot as the mountainous surroundings are well drained with only a few lakes.

Figure 47 – Umiujaq Chart

4.1.8 Sanikiluaq

Table 12 – Sanikiluaq Demographics

Population	882
Location	Latitude: 56° 32' 27.8" (56.5411°) North Longitude: 79° 13' 32.7" (79.2258°) West Elevation: 13 meters (43 feet)
Description	Sanikiluaq is Nunavut's Southernmost community, located in the Belcher Islands of Southeastern Hudson Bay about 150 kilometers (93 miles) off the coast of Québec.

Figure 48 – Sanikiluaq

4.1.9 Kuujjuarapik

Table 13 – Kuujuuarapik Demographics

Population	686
Location	Latitude: 55° 15' 1.1" (55.2503°) North Longitude: 77° 44' 58.2" (77.7495°) West Elevation: 76 metres (249 feet)
Description	Kuujjuarapik is nestled in golden sand dunes at the mouth of the Great Whale River. Beyond the village, the land is rather flat; a carpet of moss and rock unfold as far as the eye can see. From the crest of the dunes, there is a good view of Hudson Bay and the Manitounuk Islands which are just a little to the north along the coast. These breath-taking islands are representative of the Hudsonian cuestas that rise along the eastern shore of Hudson Bay. They are characterized by rocky beaches on the side facing the open sea and vertiginous cliffs on the coastal side. The Manitounuk Islands constitute an ideal shelter for birds, seal, whale and beluga. About 12 km up the Great Whale River, there is an enchanting waterfall, the Amitapanuch Falls.

Figure 49 – Kuujjuarapik Chart

4.1.10 Roggan River

Table 14 – Roggan River Demographics

Population	0
Location	Latitude: 54° 25' 1.1" (54.417°) North Longitude: 79° 27' 58.9" (79.4664°) West Elevation: 6 metres (20 feet)
Description	An uninhabited old trading post.

Figure 50 – Roggan River

4.1.11 Chisasibi

Table 15 – Chisasibi Demographics

Population	2967
Location	Latitude: 53° 47' (53.7833°) North Longitude: 78° 54' (78.9°) West Elevation: 12 metres (39 feet)
Description	Formerly the island community of Fort George, is situated on the Eastern coast of James Bay. During a two-and-half year period at the end of 1978 to 1980, Chisasibi was relocated with its 2,000 inhabitants and about 200 houses to the mainland after the La Grande hydroelectric dam was built upriver.

Figure 51 – Chisasibi and La Grande River

4.1.12 Wemindji

Table 16 – Wemindji Demographics

Population	1400
Location	Latitude: 53° 0' 39" (53.0108°) North Longitude: 78° 49' 49" (78.8303°) West Elevation: 15 metres (49 feet)
Description	Wemindji sits at the mouth of the Maquatua River on the East coast of James Bay, in Northern Quebec, Canada. Wemindji amenities include a school, a community center, cultural villages, a shopping center/mini-mall, its own hydro-electric plant, a full equipped fire station and police station, a clinic, numerous business ventures such as a gas station, a motel, a bed and breakfast, outfitting, and adventure tourism.

Figure 52 – Wemindji

4.1.13 Eastmain

Table 17 – Eastmain Demographics

Population	866
Location	Latitude: 52° 14' 33.8" (52.2427°) North Longitude: 78° 30' 33.9" (78.5094°) West Elevation: 6 metres (20 feet)
Description	Eastmain is located on the east coast of James Bay, on the South shore of the Eastmain River. The territory of Eastmain, designated as Category 1 land, is comprised of 489.53 square kilometers. The town itself has about 8 kilometers of, now paved, roads and is accessible year round by a gravel access road and via Air Creebec.

Figure 53 – Eastmain

4.1.14 Waskaganish (Fort Rupert)

Tables 18 – Waskaganish (Fort Rupert) Demographics

Population	2196
Location	Latitude: 51° 29' (51.4833°) North Longitude: 78° 45' (78.75°) West Elevation: 21 metres (69 feet)
Description	As the birthplace of the Fur Trade and as one of the oldest settlements in Canada, Waskaganish remains one of the most historically significant place from which a continent was built. Today Waskaganish is a growing, vibrant community with an on-reserve population of approximately 2300 people. Cree is the dominant language spoken, although the younger generations are becoming fluent in English and French as well. Trapping remains an important contributor to the local economy as well as a source of cultural and spiritual values. Many consider the community and its territory as one of North-America's premier destination for migratory birds. The region is well known for its waterways and prime fishing spots, hosting an annual canoe brigade every summer.

Figure 54 – Waskaganish

4.1.15 Moosonee

Table 19 – Moosonee Demographics

Population	1481
Location	Latitude: 51° 16' 45.5" (51.2793°) North Longitude: 80° 38' 4.2" (80.6345°) West Elevation: 10 metres (33 feet)
Description	Moosonee is located on the Moose river. The town site is in the Hudson Bay Lowlands, the largest wetland area on earth. Moosonee serves as a gateway to the North and a launching point for further destinations, whether across the Moose River to Moose Factory, or further North up the western coast of James Bay.

Figure 55 – Dockage Area

4.1.16 Moose Factory

Table 20 – Moose Factory Demographics

Population	672
Location	Latitude: 51° 16' 45.5" (51.2793°) North Longitude: 80° 38' 4.2" (80.6345°) West Elevation: 10 metres (33 feet)
Description	Moose Factory is located on the Moose river. The town site is in the Hudson Bay Lowlands, the largest wetland area on earth. The community is comprised mostly of Cree. Facilities include a hospital. In summer, a water taxi service is available between Moosonee and Moose Factory.

Figure 56 – Moose Factory

4.1.17 Fort Albany

Table 21 – Fort Albany Demographics

Population	759
Location	Latitude: 52° 11' 59.9" (52.2°) North Longitude: 81° 39' 59.9" (81.6666°) West Elevation: 11 metres (36 feet)
Description	First Nations reserve adjacent to Kashechewan on the Albany River. Fort Albany is connected to its neighbor via a ferry system in summer and ice road in winter.

Figure 57 – Fort Albany is Located on the Southern Shore of the Moose River

4.1.18 Kashechewan

Table 22 – Kashechewan Demographics

Population	1900
Location	Latitude: 52° 17' 28.5" (52.2913°) North Longitude: 81° 38' 24.9" (81.6403°) West Elevation: 7 metres (23 feet)
Description	The community is located on the Northern shore of the Albany River. Kashechewan First Nation is one of two communities that were established from Old Fort Albany (now the Fort Albany 67 Indian Reserve) in the 1950s. The community is connected to other towns along the shore of James Bay by the seasonal ice road/winter road, linking it to the towns of Attawapiskat, Fort Albany, and Moosonee.

Figure 58 – Kashechewan

4.1.19 Attawapiskat

Table 23 – Attawapiskat

Population	1501
Location	Latitude: 52° 55' 39.9" (52.9277°) North Longitude: 82° 25' 0.1" (82.4167°) West Elevation: 5 metres (16 feet)
Description	Located at the mouth of the Attawapiskat River on James Bay. The community is connected to other towns along the shore of James Bay by the seasonal ice road/winter road constructed each December, linking it to the towns of Kashechewan First Nation, Fort Albany, and Moosonee.

Figure 59 – Attawapiskat

4.1.20 Peawanuck

Table 24 – Peawanuck Demographics

Population	195
Location	Latitude: 55° 1' 8.2" (55.019°) North Longitude: 85° 24' 55.6" (85.4154°) West Elevation: 39 metres (128 feet)
Description	Located near the confluence of the Winisk and Shamattawa rivers, about 35 km from the Winisk River's end in Hudson Bay. Its population used to live in the community of Winisk (55°16′N 85°11′W), near the mouth of the Winisk River. This also used to be a Mid-Canada Line Radar site.

Figure 60 – Peawanuck

4.1.21 Fort Severn

Table 25 – Fort Severn Demographics

Population	361
Location	Latitude: 56° 1' 8" (56.0189°) North Longitude: 87° 40' 34" (87.6761°) West Elevation: 12 metres (39 feet)
Description	The town is linked by winter/ice road called the Wapusk Trail the winter to Peawanuck, Ontario in the East, and Shamattawa and Gillam, Manitoba to the West. Fort Severn is policed by the Nishnawbe-Aski Police Service, an Aboriginal-based service.

Figure 61 – Fort Severn

4.1.22 Churchill

Table 26 – Churchill Demographics

Population	899
Location	Latitude: 58° 46' 5.2" (58.7681°) North Longitude: 94° 10' 0.3" (94.1667°) West Elevation: 9 metres (30 feet)
Description	Located in Northern Manitoba on the west shore of Hudson Bay, roughly 110 kilometers (68 miles) from the Manitoba–Nunavut border. It is most famous for the many polar bears that move toward the shore from inland in the autumn, leading to the nickname "Polar Bear Capital of the World" that has helped its growing tourism industry.

Figure 62 – Churchill

4.1.23 Arviat

Table 27 – Arviat Demographics

Population	2657
Location	Latitude: 61° 6' 31.8" (61.1088°) North Longitude: 94° 3' 30.5" (94.0585°) West Elevation: 1 metre (3 feet)
Description	Arviat is one of the most Southerly and accessible Inuit communities. Arviat is located on the Western shores of Hudson Bay. Framed in by several large barrenland rivers, Arviat is surrounded by lively, rolling tundra, an intriguing land rich in wildlife, a gently rolling landscape dotted with lakes and ponds, and steeped in Inuit culture. The second-largest community in Nunavut, Arviat remains closely tied to its traditional Inuit roots, and in addition to having a vibrant arts and crafts industry is also becoming a centre of mine training and employment for the Kivalliq Region.

Figure 63 – Arviat

4.1.24 Whale Cove

Table 28 – Whale Cove Demographics

Population	435
Location	Latitude: 62° 10' 17" (62.1714°) North Longitude: 92° 34' 40.2" (92.5778°) West Elevation: 1 metre (3 feet)
Description	Whale Cove is a small Inuit community in the Kivalliq region of the Canadian Arctic. Local geography is defined by rolling hills, wild beaches, and many lakes and rivers. From April to June, the people of Whale Cove fish at the many nearby lakes and rivers nearby for award-winning lake trout and world-renowned Arctic char. The annual fishing derby is a time-honored tradition that brings people from all over the region to compete for the biggest lake trout. June to August finds many families taking advantage of endless days, camping on the land, hunting for seals or whales, or swimming at Old Water Lake.

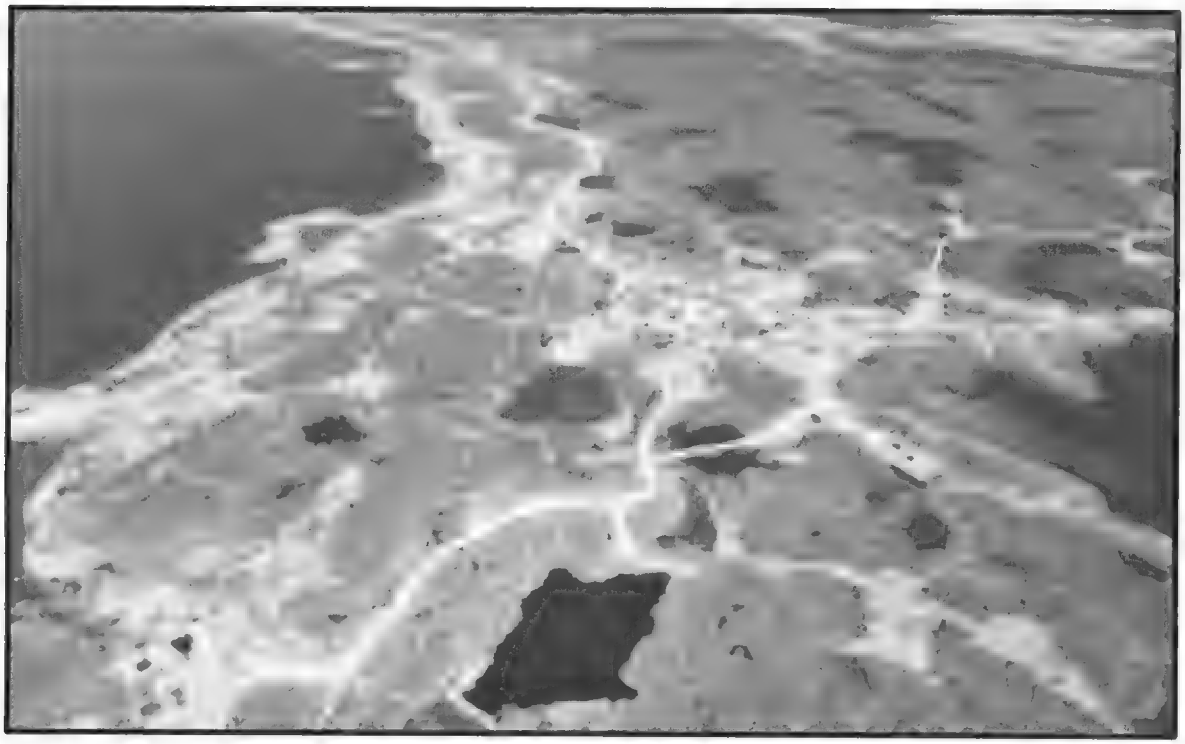


Figure 64 – Whale Cove

4.1.25 Rankin Inlet

Table 29 – Rankin Inlet Demographics

Population	2842
Location	Latitude: 62° 48' 32.6" (62.8091°) North Longitude: 92° 5' 7.2" (92.0853°) West Elevation: 1 metre (3 feet)
Description	The community is served by annual supply sealift. Groceries and household goods can be purchased at The North West Company's Northern Store or at the Kissarvik Cooperative. In 2018, an IRB station began seasonal operation in this community with a crew of 4.

Figure 65 – Rankin Inlet

4.1.26 Chesterfield Inlet

Table 30 – Chesterfield Inlet

Population	437
Location	Latitude: 63° 20' 31.6" (63.3421°) North Longitude: 90° 42' 18" (90.705°) West Elevation: 1 metre (3 feet)
Description	Known in Inuk as "place with few houses", it is the oldest community in Nunavut. The community is served by air, Chesterfield Inlet Airport, and by an annual supply sealift. The Inuit people from the Chesterfield Inlet region are called Qaernermiut, though previously, they were referred to as Kenepitic, Kenepetu or Kenepitu.

Figure 66 – Chesterfield Inlet

4.1.27 Coral Harbor

Table 31 – Coral Harbour Demographics

Population	891
Location	Latitude: 64° 8' 17.8" (64.1383°) North Longitude: 83° 9' 55.4" (83.1654°) West Elevation: 1 metre (3 feet)
Description	Coral Harbours, known as Salliq ("large, flat island in front of the mainland") by the Inuit, was named for the fossilized coral found at nearby Fossil Creek. From the earliest Inuit hunters of the Sallirmiut, to the Scottish whalers, to the Hudson's Bay fur traders, to the military air base, it has long served as a strategic point on the northern rim of Hudson Bay.

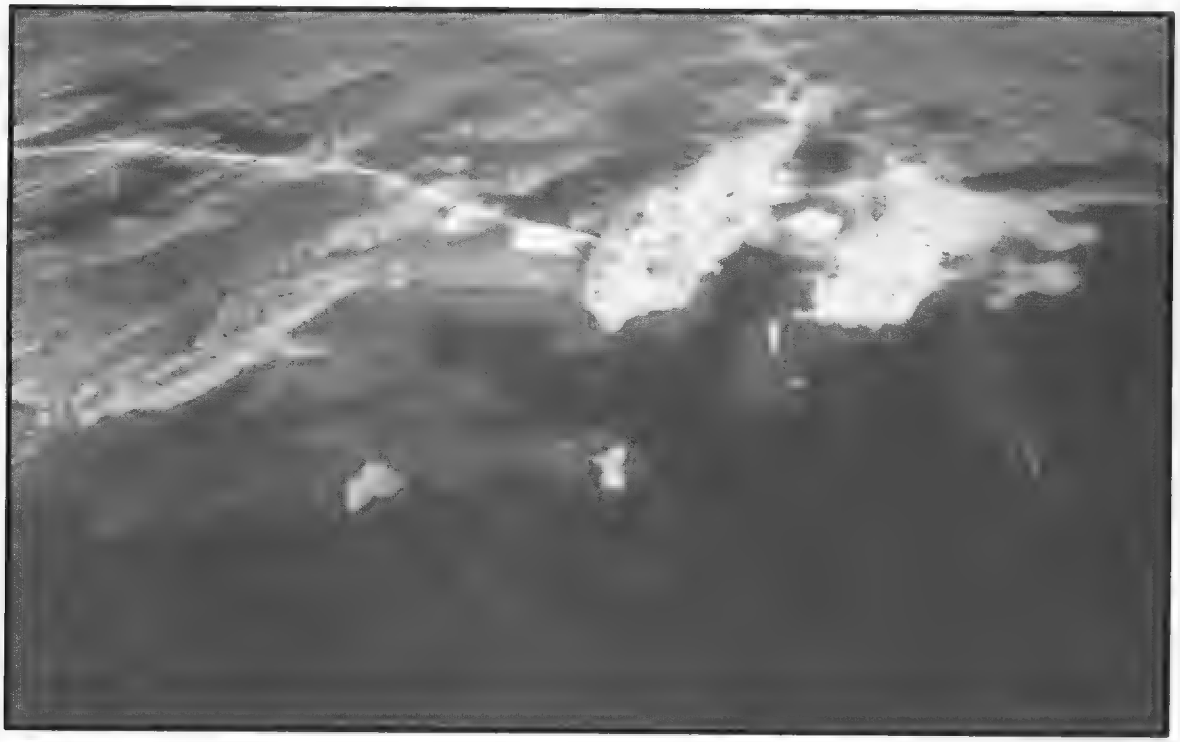


Figure 67 – Coral Harbour

4.1.28 Naujaat

Table 32 – Naujaat Demographics

Population	1082
Location	Latitude: 66° 31' 44.9" (66.5291°) North Longitude: 86° 14' 37.4" (86.2437°) West Elevation: 1 metre (3 feet)
Description	Located right on the Arctic Circle, at the north end of Repulse Bay on the Southern shores of Rae Isthmus. The Inuktitut name of this community is 'Naujaat' ('seagull nesting place') for a cliff area nearby where fledgling seagulls are born each June. Its people are known for their excellent dog teams and walrus hunting skills. Popular activities include viewing polar bears, whale watching excursions, and visiting Ukkusiksalik National Park.

Figure 68 – Naujaat

4.1.29 Hall Beach

Table 33 – Hall Beach Demographics

Population	848
Location	Latitude: 68° 47' 28.8" (68.7913°) North Longitude: 81° 14' 9.5" (81.236°) West Elevation: 2 metres (7 feet)
Description	Known in Inuk language as Sanirajaq, meaning 'the shoreline', the Inuit of Hall Beach have enjoyed and benefitted from the abundance of marine life, including walruses and beluga whales for thousands of years due to a recurring polynya near the community.

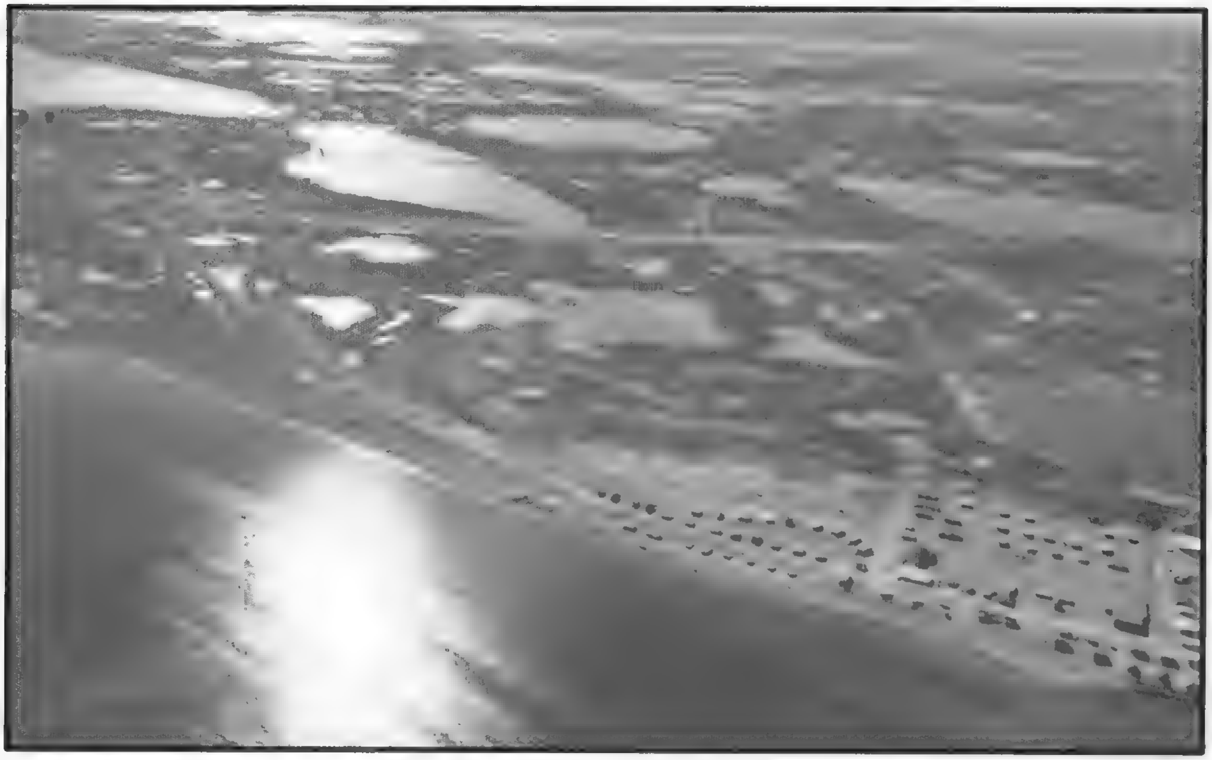


Figure 69 – Hall Beach

4.1.30 Igloolik

Table 34 – Igloolik Demographics

Population	1682
Location	Latitude: 69° 22' 39.8" (69.3777°) North Longitude: 81° 47' 59.7" (81.7999°) West Elevation: 1 metre (3 feet)
Description	Igloolik is an Inuit community in Foxe Basin North of the Arctic Circle. Icebergs drift past the island through the narrows of Fury and Hecla Strait, which also funnels migrating beluga and bowhead whales, herds of walrus and pods of narwhal to within easy viewing distance in spring.

Figure 70 – Igloolik

4.2 Deep Water Ports

Churchill, Manitoba has four deep-sea berths for the loading and unloading of grain, bulk commodities, general cargo, and tanker vessels. It is currently closed due to damaged train lines leading to the port and low demand.

Figure 71 – Port of Churchill on October 5, 2007. (John Woods)

4.3 Maritime Activity Statistics

Vessel movements in SAR Area 155 from 2012 – 2016 were tracked using the INNAV database provided by Coast Guard MCTS centres for NORDREG. A significant amount of vessel traffic is related to mining activity in the area. The busiest port was Deception Bay, a company-owned port used for moving resources to and from Ungava Peninsula mines. Factors affecting commercial port visits include: lack of road access, population, nearby communities, and overall economic activity.

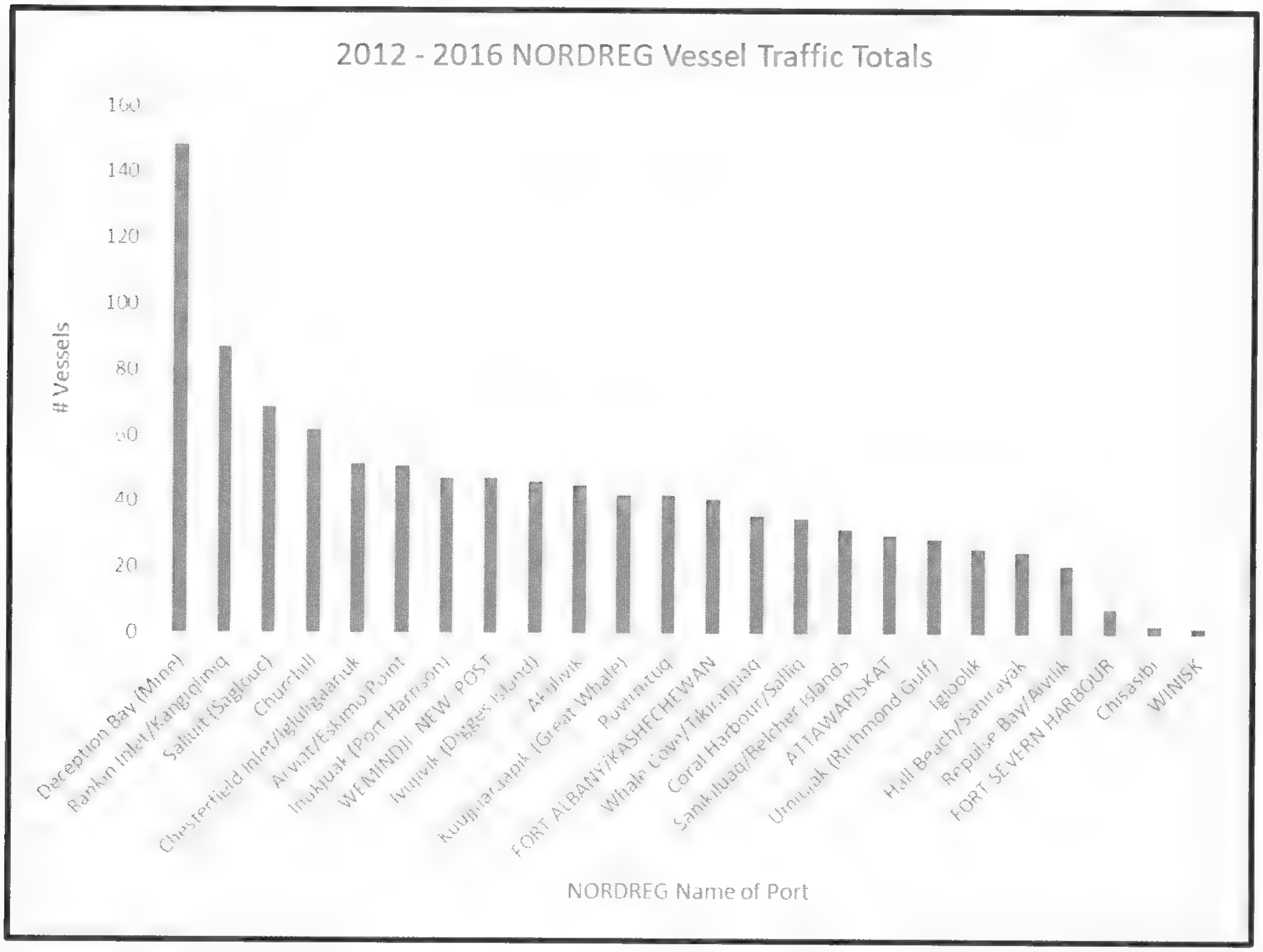


Figure 72 – Vessel Traffic Totals

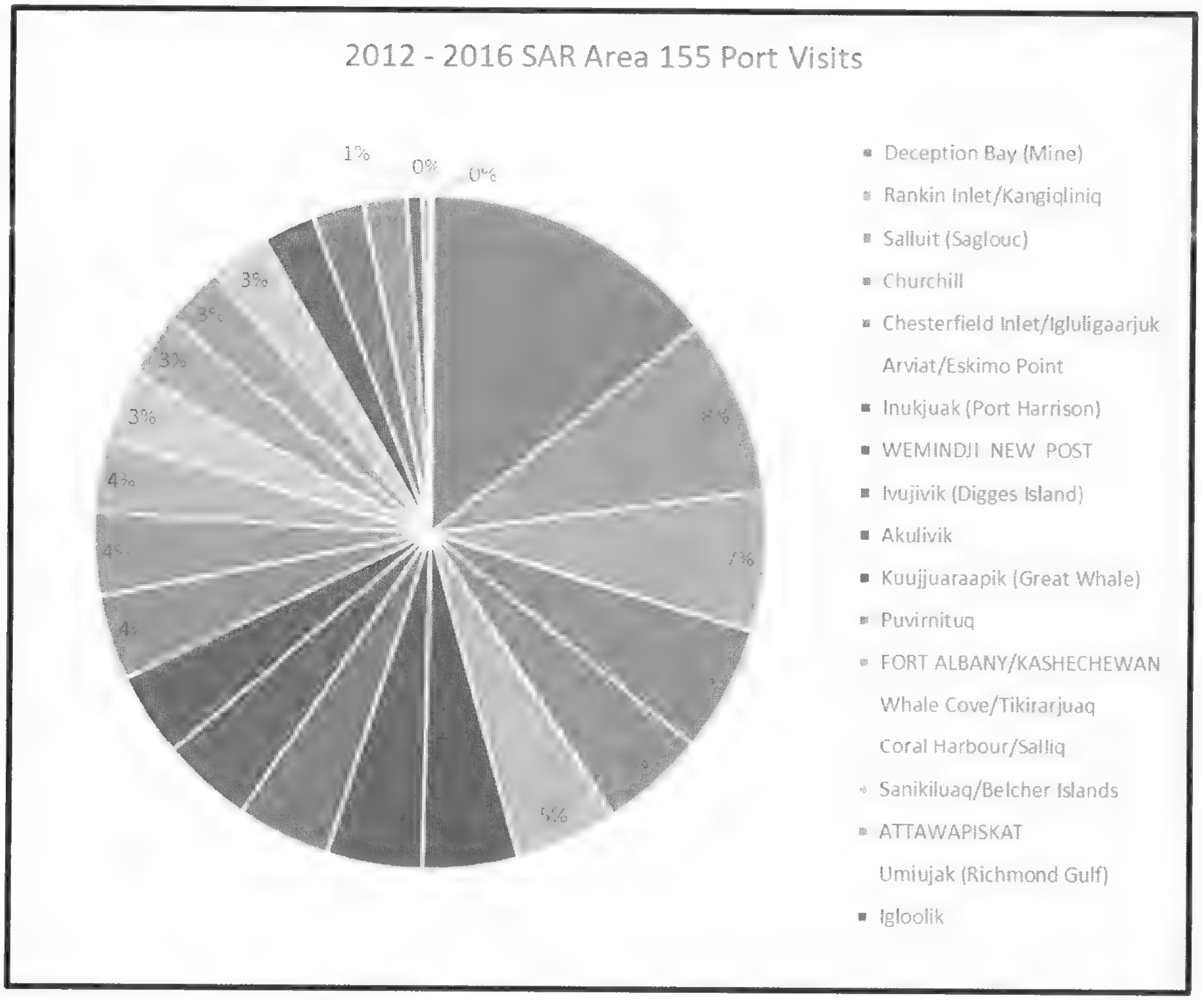


Figure 73 – Number of Port Visits

The most common type of vessel to enter Hudson Bay was a 'merchant general' vessel. High counts of tug boat port visits is misleading, as most tug boats only make short trips between communities in 2 days or less. Cargo vessels typically do not make more than three trips to the Arctic per year. Of note is approximately 200 vessels carrying oil, fuel, ore, and chemicals which transited the region. The hazards associated with an oil or chemical spill are significant due to impacts on local communities, fishing areas, and risk of fire.

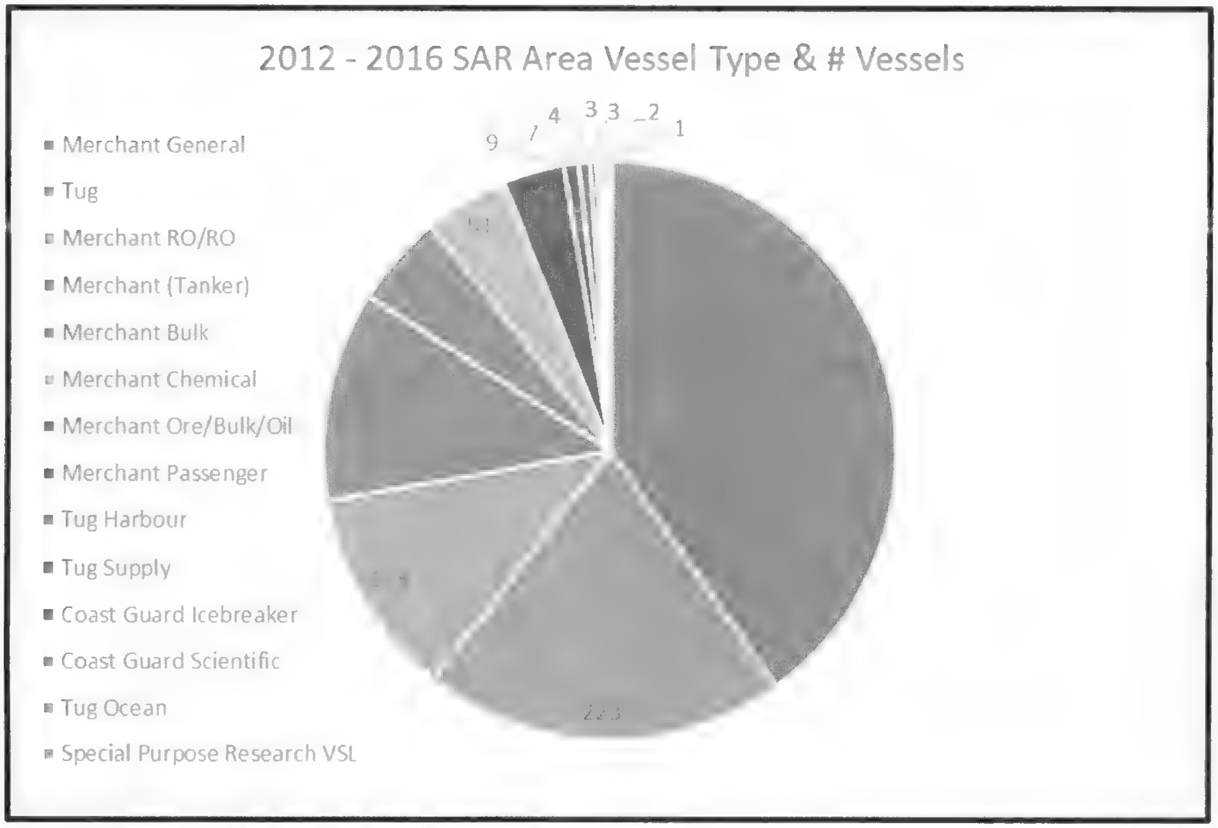


Figure 74 – Vessel Types in SAR Area 155

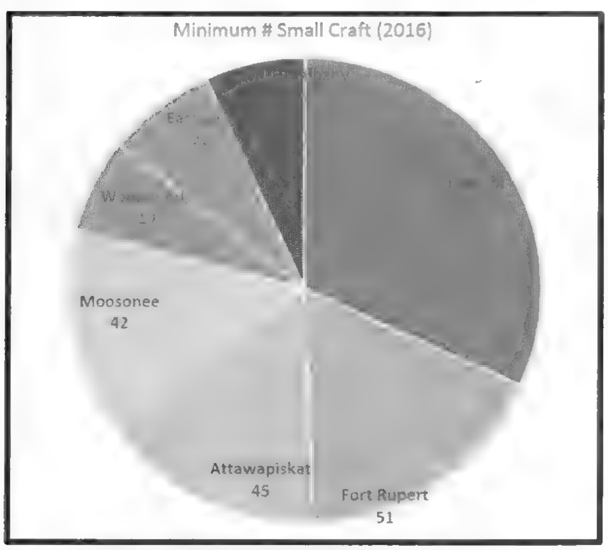


Figure 75 – Small Craft in James Bay

There are approximately 300 small craft in James Bay. These vessels are primarily used by locals for fishing and hunting. Depending on proximity to neighboring communities, small craft have been known to make long-range transits between communities in unsheltered waters. Using Google Street View, analysts counted the number of small craft seen in each community

4.3.1 Ferry Operations

Attawapiskat, Fort Albany, Moosonee, Fort Rupert, and Eastmain all have ferry services across their nearest river.

4.3.2 Commercial Fishing

There is no commercial fishing in area 155.

4.3.3 Recreational Fishing

Quantifying recreational fishing in Area 155 is elusive. Many people in the region fish, but due to Inuit and Cree traditions, food insecurity, and high unemployment; fishing is rarely done recreationally by locals. Guides and outfitting companies exist in every community which offer fishing trips to visitors and tourists. It is known that 472 PCOC's have been issued to addresses in Nunavut since 1991, perhaps for the purpose of boating and fishing in other provinces/Yukon. Proof of competency is not required in Nunavut or the NWT.

4.3.4 First Nations Maritime Activities

Inuit and Cree maintain a close relationship with the geography in which they live. "Harvesting" is the general term used to describe the act of hunting, trapping, gathering, and fishing in Northern communities.

Harvesting is reported as a percentage of people in a community who take part in hunting and fishing at various frequencies. It is challenging to create any distinction between those who exclusively hunt versus the population of mariners. Participating in once activity is not mutually exclusive of the other.

4.3.5 Eco-tourism Operations

All communities operate one or more outfitters.

4.3.6 Commercial Cargo Operations

INNAV data was compiled for vessels operating in the NORDREG zone from 2012 – 2016. Any vessel which made 3 or more port visits in NORDREG during this time have been included in this list. A search was run for each vessel via the Transportation Safety Board of Canada (TSBC) database from 1991 – 2019. Wherever a vessel has been involved in a TSBC marine investigation, a brief summary is provided.

Moosonee, Fort Albany, and Attawapiskat are all served by a tugboat service which delivers goods and natural resources between communities. The following vessels are known to conduct tug operations in NORDREG.

Table 35 – Vessel Traffic

Tug Vessel:	LOA (m)	Transportation Safety Board of Canada Remarks
Alex Gordon	63	No marine investigation reports exist for this cohort of vessels from 1991 – 2019.
Bert Long	21	
Bob's Welding 1	14	
Edgar Kotokak	47	
Fathom Wave	19	
Henry Christoffersen	47	
Island Tugger	36	
Jim Kilabuk	63	
Kelly Ovayuak	45	
Nunakput	52	
Pisurayak Kootook	49	
Risco Reegan	20	
Vic Ingraham	47	
W.H. Horton	18	

Table 36 – Merchant Vessels Known to Regularly Transit Through NORDREG

Merchant Tankers:	LOA (m)	Transportation Safety Board of Canada Remarks
Alsterstern	161	No investigations
Dara Desgagnes	124	No investigations
Espada Desgagnes	228	No investigations
Havelstern	161	No investigations
Jana Desgagnes	123	No investigations
Maria Desgagnes	120	On 12 September 2005, Maria Desgagnes collided with Sailing vessel El Tio in the St. Lawrence River.
Nanny	116	Ran aground October 25 2012 while outbound from Baker Lake, NU damaging forward section of hull. Refloated Oct 27 and proceeded to St. John's, NFLD for repairs. No injuries or pollution reported. Nanny ran aground a second time on Oct 14, 2014 near Chesterfield Inlet.
Sarah Desgagnes	147	No investigations
Travestern	161	No investigations
Uvaq	164	No investigations
Ugale	195	No investigations
Merchant General:		
Anna	173	On 29 Aug 2017; Vessel lost power and subsequently ran aground near Beauharnois, Quebec.
Avataq	113	No investigations
Claude A Desgagnes	138	On 6 Nov 2013, struck the approach wall of Iroquois Lock in St. Lawrence Seaway. Subsequently, the vessel ran aground. No pollution or injuries reported, the ship sustained minor damage.
Mitiq	136	No investigations
Qamutik	136	No investigations
Rosaire A. Desgagnes	138	No investigations
Sedna Desgagnes	139	No investigations
Umiavut	113	No investigations
Zelada Desgagnes	138	No investigations

4.3.7 Cruise Ship Operations

Table 37 – Cruise Ship Operations

Merchant Passenger	LOA (m)	Transportation Safety Board of Canada Remarks
Akademik Ioffe	117	Investigation underway. Ran aground in 2018.
Bremen	111	No investigations
Crystal Serenity	250	No investigations
Hanse Explorer	47	No investigations
Hanseatic	123	On 29 August 1996, ran aground in Simpson Straight, NWT.
KAPITAN KHLEBNIKOV	129	No investigations
L'Austral	142	No investigations
Le Boreal	142	No investigations
Le Soleal	142	No investigations
NatGeo Explorer	112	No investigations
Ocean Endeavour	137	No investigations
Sea Adventurer	100	No investigations
Sea Explorer I	90	No investigations
Silver Explorer	108	No investigations
The World	196	No investigations

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Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Coast Guard | Garde côtière canadienne

Annex D: Environmental Scan

SAR AREA 260

Maritime Search and Rescue Arctic Analysis

Canadian Coast Guard
Search and Rescue Risk Analysis (SARRA)
March 2019

Annex D: Environmental Scan – Area 260

The Regional SAR Risk Analysts for the Arctic would like to extend acknowledgement for this Environmental Scan to the following organizations:

Canadian Hydrographic Service
Canadian Ice Services
Department of Fisheries and Oceans
Environment and Climate Change Canada
Joint Rescue Coordination Centre Trenton
National Oceanic and Atmospheric Administration
National Aeronautics and Space Administration
Oceans Ltd

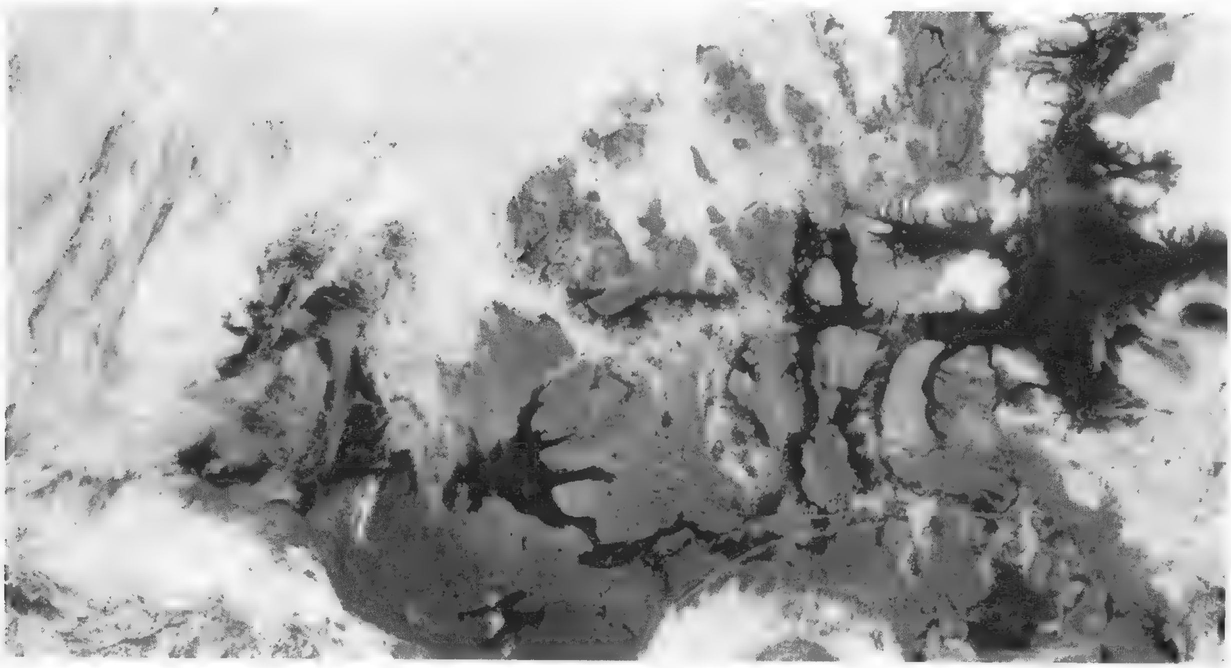

Figure 1 – Composite satellite imagery of prominent features in SAR Area 260.

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Annex D: Environmental Scan – Area 260

Executive Summary

Search and Rescue (SAR) Area 260 underwent a Search and Rescue Risk Analysis (SARRA) using the Risk Based Analysis of Maritime SAR Delivery (RAMSARD) Methodology to study climate, geography, demographics, and human activity in the Arctic. The Environmental Scan is an important aspect of the risk analysis process and was designed to help evaluating risks to mariners in Search and Rescue Areas (SRA) on Coast Guard mandated waters. Environmental scans can help the Canadian Coast Guard (Coast Guard) shape its resource management plans in response to rapids changes and create a vision of future requirement.

Summarized findings

- ❖ Cambridge Bay, Pond Inlet, and Kugluktuk are common stop-over locations where cruise ships allow passengers to disembark.
- ❖ Commercial fishing occurs in Baffin Bay during the height of summer.
- ❖ SAR Area 260 is the busiest Arctic SAR Area for passenger vessels. Most research and cruise journeys are bound for this region and will spend the majority of their trip within 260.
- ❖ Marine conditions are poor for small craft operation 20.9% of the time in autumn due to waves greater than 2.0m.
- ❖ 4.9% of SAR Area 260 is navigable with <15cm of ice at the height of summer. The remainder requires a polar-class icebreaking vessel to make passage.

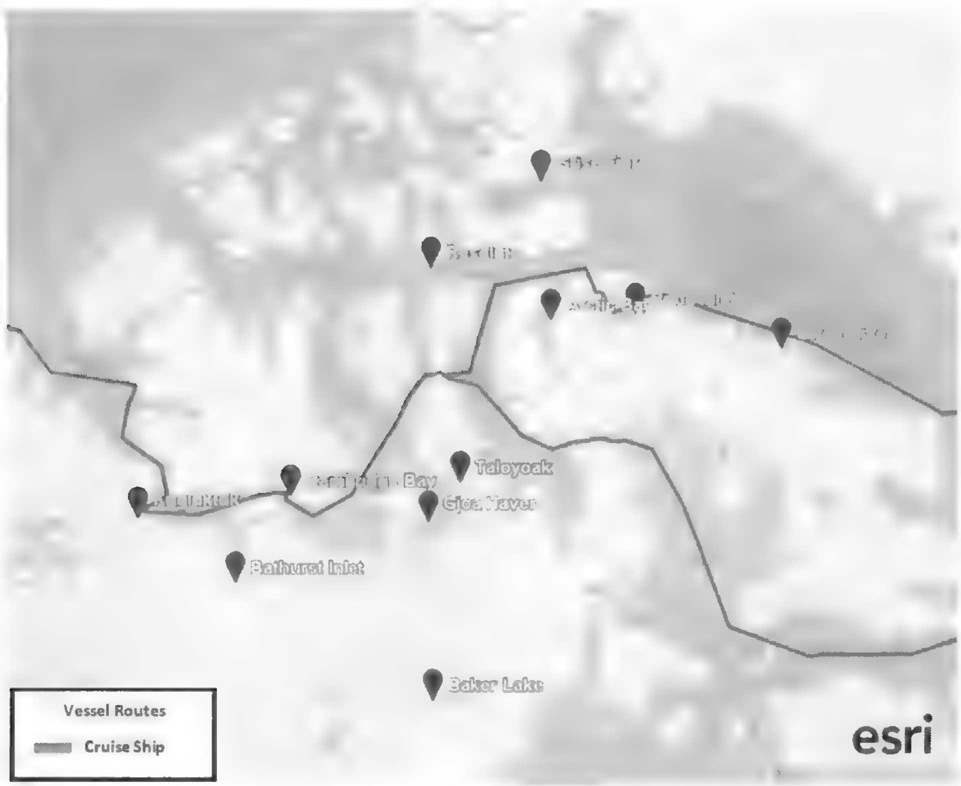

Figure 2 – Overview of SAR Area 260

1. Maps of SAR Area

1.1 Maps

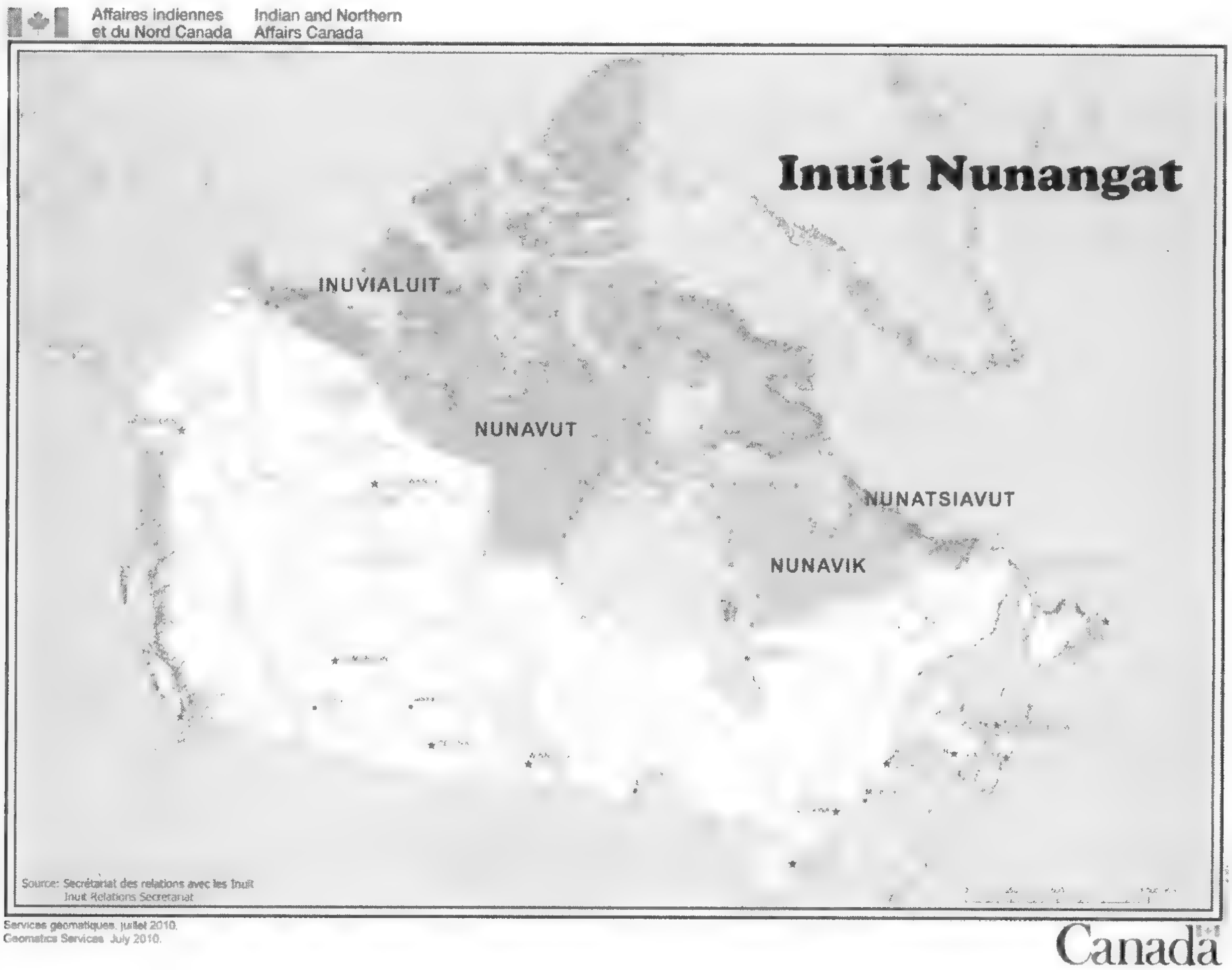

Figure 3 – Inuit Nunangat of Canada

Annex D: Environmental Scan – Area 260

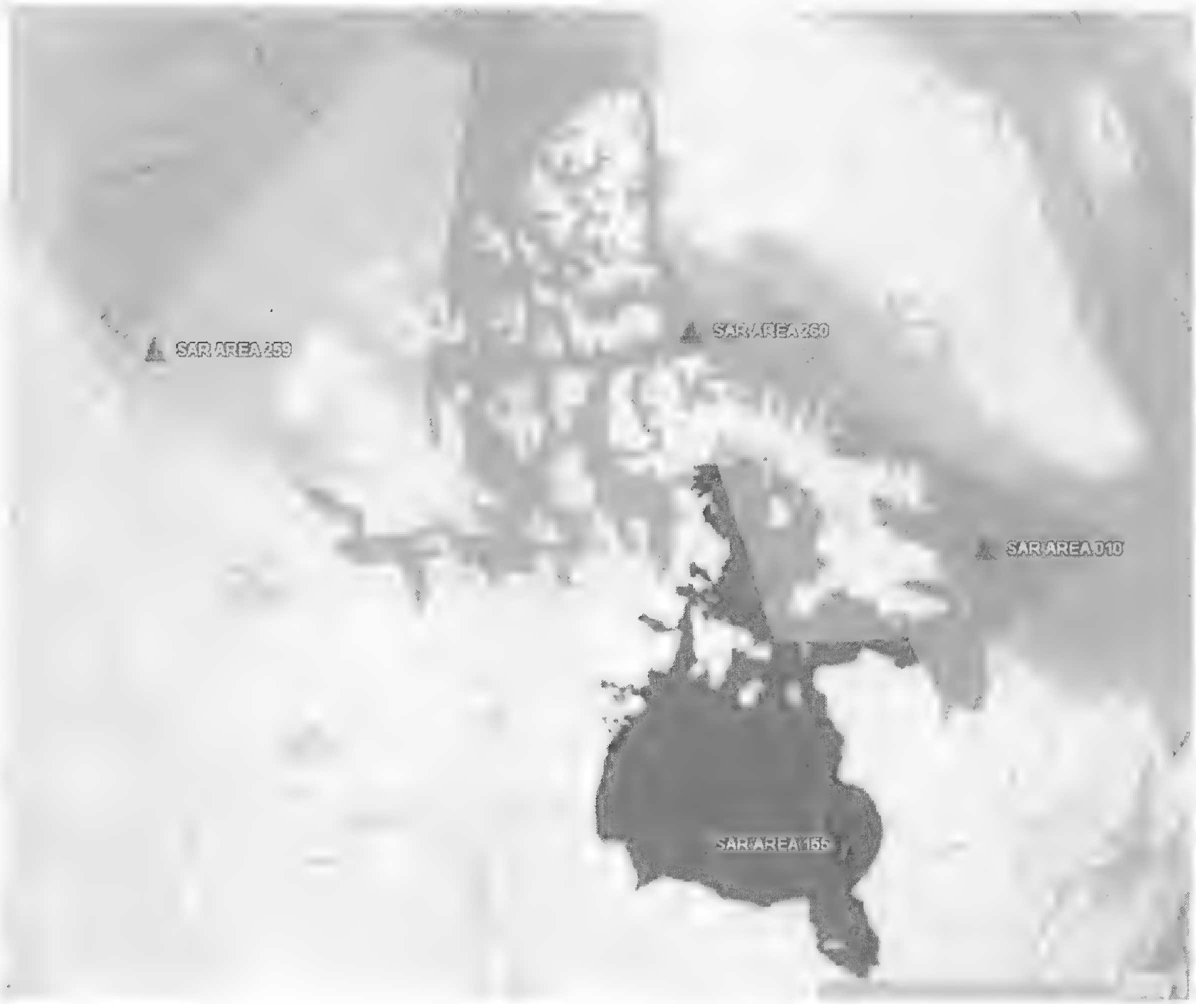

Figure 3 – RAMSARD defined regions of study. The Arctic includes 010, 155, 259, and 260. These are the boundaries for maritime SAR.

Annex D: Environmental Scan – Area 260

Figure 5 – SAR Area 260

1.2 Description of Dimensions & Distances

SAR Area 260 encompasses all land and water areas of the Nunavut except Baffin Island from 70°N southward and 64°W eastward. Islands in Hudson and James Bay are included as lands of Nunavut and part of SAR Area 260. Prominent features include Alex Heiberg, Ellesmere, Bathurst, Devon, Prince of Wales, Somerset, and Baffin Islands.

The Arctic region includes: Clyde River, Pond Inlet, Arctic Bay, Nanisivik, Resolute, Grise Fiord, Kugaaruk, Taloyoak, Gjoa Haven, Cambridge Bay, Kugluktuk, Eureka Research Base, Isachsen Research Base, Alert, and Sanikiluaq.

The Joint Rescue Coordination Centre in Trenton, ON is responsible for SAR coordination in this SAR Area.

2. Climatology & Oceanography

Numerous climate factors are significant to the SAR program. The examination of climate by season in each SAR Area are conducted using 30 year climate normals for parameters including: prevailing wind direction, mean seasonal and maximum wind speed, percentage frequency of wave height greater than 2.0 metres, mean air temperature, mean seasonal minimum sea surface temperature, percentage frequency of visibility less than 1 nautical mile, percentage of fog occurrence, mean seasonal maximum of current speed, mean seasonal sightings of icebergs, mean days per season of ice coverage with concentration greater than 7/10ths and thickness greater than 15 cm, and presence of old ice and first-year ice.

For the purpose of this Environmental Scan, the seasons are defined as:

- Winter – December, January, February
- Spring – March, April, May
- Summer – June, July, August
- Fall – September, October, November

2.1 Prevailing Wind Direction

Prevailing wind direction in SAR Area 260 is 10 knots from the northwest (NW).[1] Storms affecting the area typically form over the Arctic Ocean where they routinely track from West to East. Storms are more prevalent in autumn and winter.

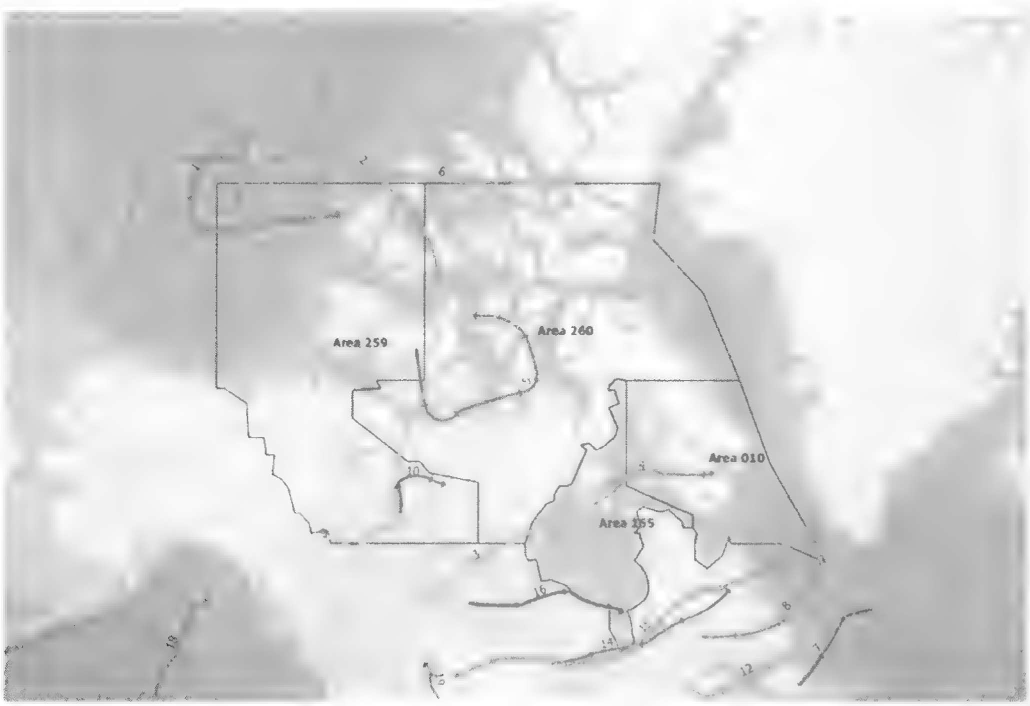

Figure 4 – Summer storm tracks

[1] Oceans, ltd. 2018. *Climate of the Canadian Coast Guard Arctic SAR regions.*

Figure 5 – Autumn storm tracks

The presence of costal features significantly influences local wind conditions. Katabatic outflow winds are common given the topography of large islands in the area.[2] Strong localized offshore winds result in unusual ice characteristics where floes are kept away from shore, leaving open water. Summer wind conditions are relatively light while the autumn boating season sees worsening conditions. Below are the mean seasonal wind speed (in knots) for SAR Area 260:

Table 1 – Mean seasonal wind speed (kts)

Season	Mean	Mean Maximum
Winter	10.4	40.5
Spring	9.9	36.7
Summer	9.1	32.1
Autumn	10.7	39.0

[2] NAV Canada. 2001. *Weather Guide for Nunavut and the Arctic.*

2.2 Waves

Typical annual wave height is 1.5 metres, increasing to a mean seasonal maximum of 3.5m during autumn.[3]

Table 2 – Significant wave height (m)

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	7.5	0.0
Spring	21.3	8.0
Summer	7.0	0.4
Autumn	20.9	3.5

2.3 Temperatures

2.3.1 Seasonal Air Temperature (°C)

Air temperature in area 260 is closely linked with the albedo effect of snowpack & ice, daylight hours, and sea surface temperature. The climate of SAR Area 260 is defined as polar (E) according to the Köppen–Geiger climate classification system. The Polar Region has two climate, the Tundra climate (ET) and the Ice cap climate (EF). The Tundra climate is classified as having mean monthly temperatures rise above 0°C for part of the year without exceeding 10°C while the Ice cap climate has eternal winter with all 12 months of the year with average temperatures below 0° C.

Kugluktuk and Baker Lake experience a **Sub-Polar** climate, defined as a region experiencing mean monthly temperatures rising above 10°C at least one month of the year.

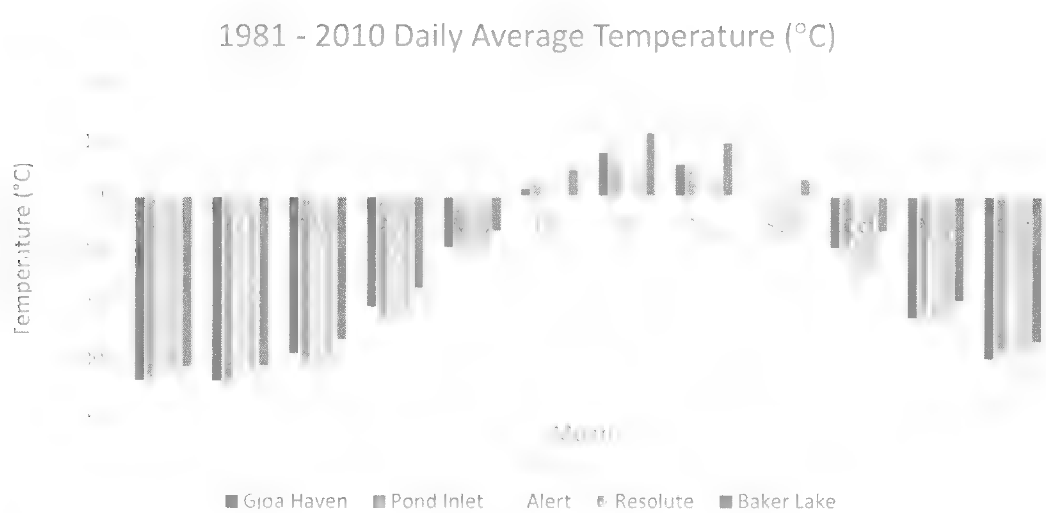

Figure 6 – Thirty year climate normals for select communities in SAR Area 260.

[3] Oceans, ltd. 2018. *Climate of the Canadian Coast Guard Arctic SAR regions.*

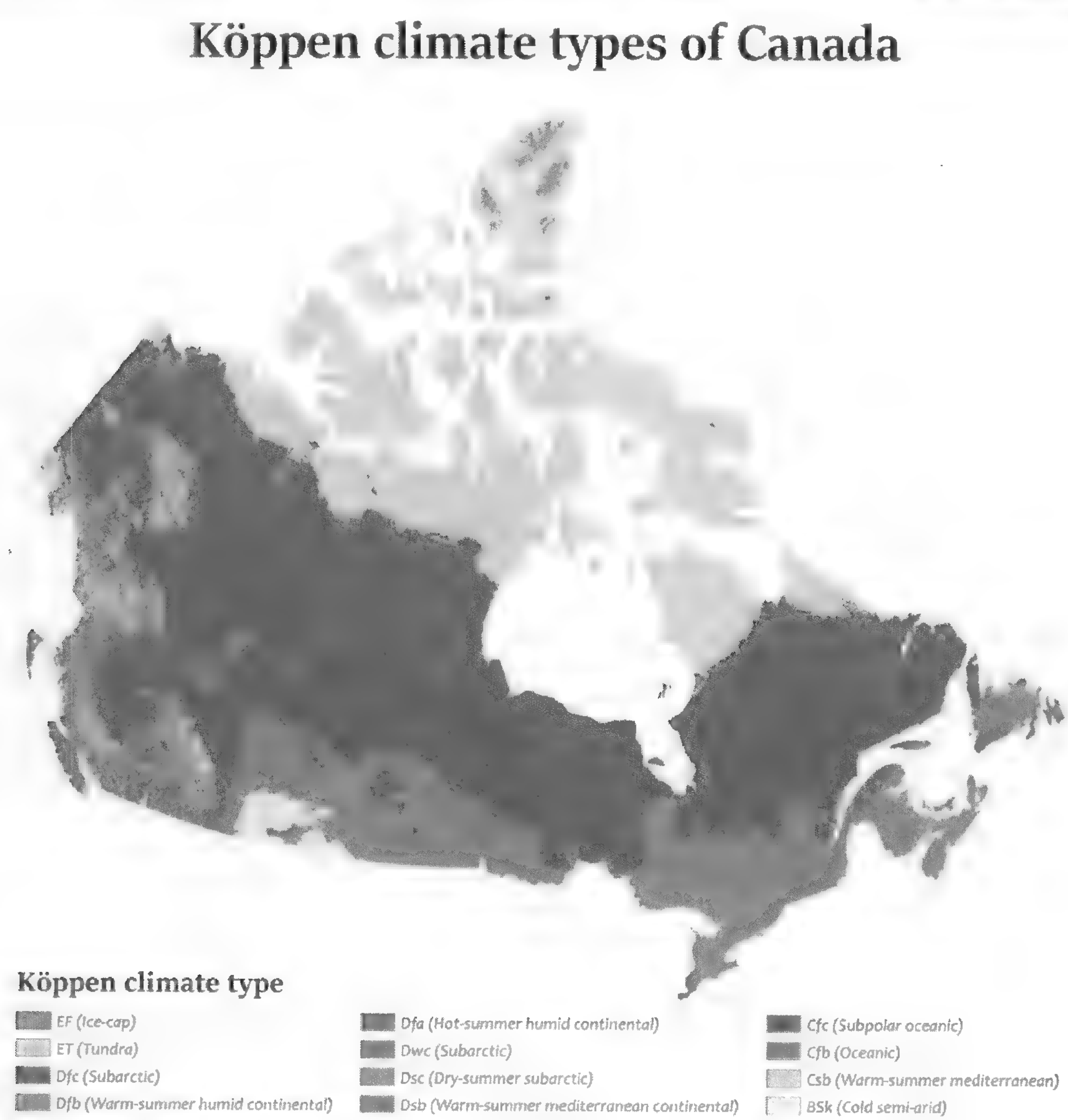

Figure 7 – Climate regions of SAR Area 260

2.3.2 Seasonal Sea Surface Temperatures

The seasonal variation of sea-surface temperatures in the Canadian Arctic during the active marine season shows a slight change. Data is not collected in winter as all of SAR Area 260 freezes into thick first year and multiyear ice, where sea surface temperatures beneath the ice hover at -1.6°C.[4]

Table 3 – Seasonal Sea Surface Temperatures for Area 260 (°C)

Season	Minimum	Maximum
Winter	N/A	N/A
Spring	-1.3	-0.5
Summer	-1.4	10.0
Autumn	-1.9	7.0

2.4 Sea Ice

Much of the ice is SAR Area 260 is multi-year and thus does not melt. 4.9% of sea ice has a thickness of less than 15cm and concentration below 7/10 during summer. In autumn, this figure rises to 8.1%. Most of area 260 is not navigable without a polar-class vessel.

Ice break up dates in SAR Area 260 are characterized by the expansion of polynyas east of Ellesmere Island in early June. Late in the season, a navigable route is established through to the Beaufort Sea with old ice enveloping the remainder of the Arctic Archipelago year round.

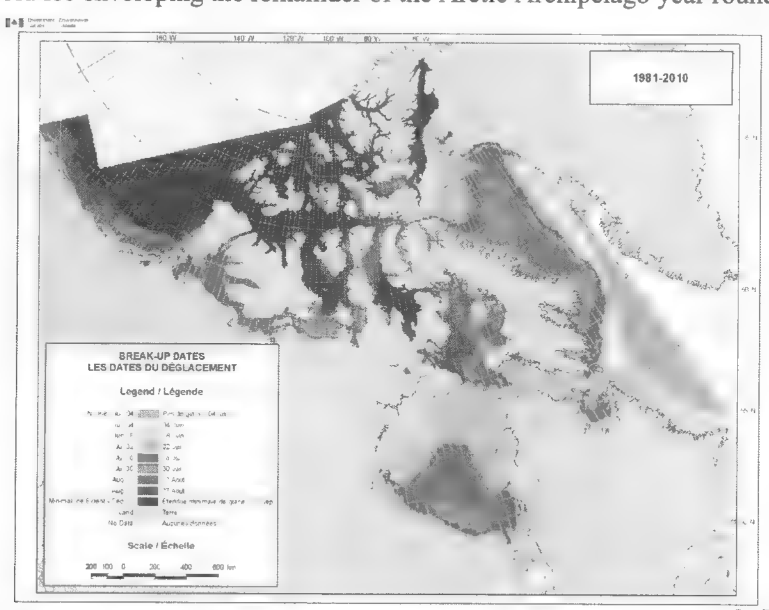

Figure 10 – Ice break up dates in SAR Area 260.

[4] From (IOCDAS) International Comprehensive Ocean-Atmosphere Data Set. Limited data available. Use with caution.

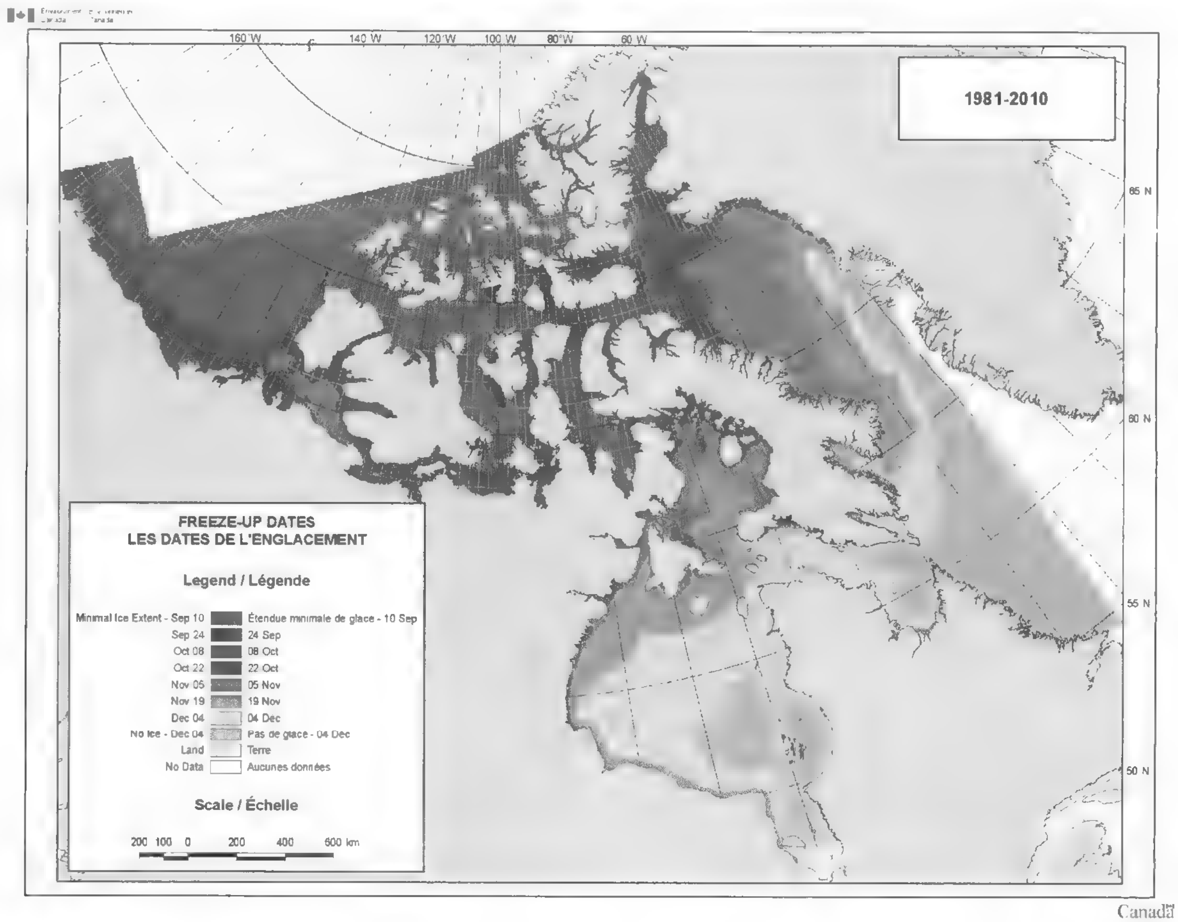

Figure 11 – Ice freeze-up dates.

2.5 Tide & Current

Currents are varied throughout SAR Area 260. The Labrador Current flows south along the eastern side of Ellesmere Island and North Baffin Island. Moderate currents exist in Parry Channel and in Jones Sound, north of Devon Island.

Tides throughout the region are 2-5 meters. Such ranges are low compared to other areas of the Canadian Arctic Archipelago. Tidal currents remain active in all inlets and channels throughout the SAR Area.

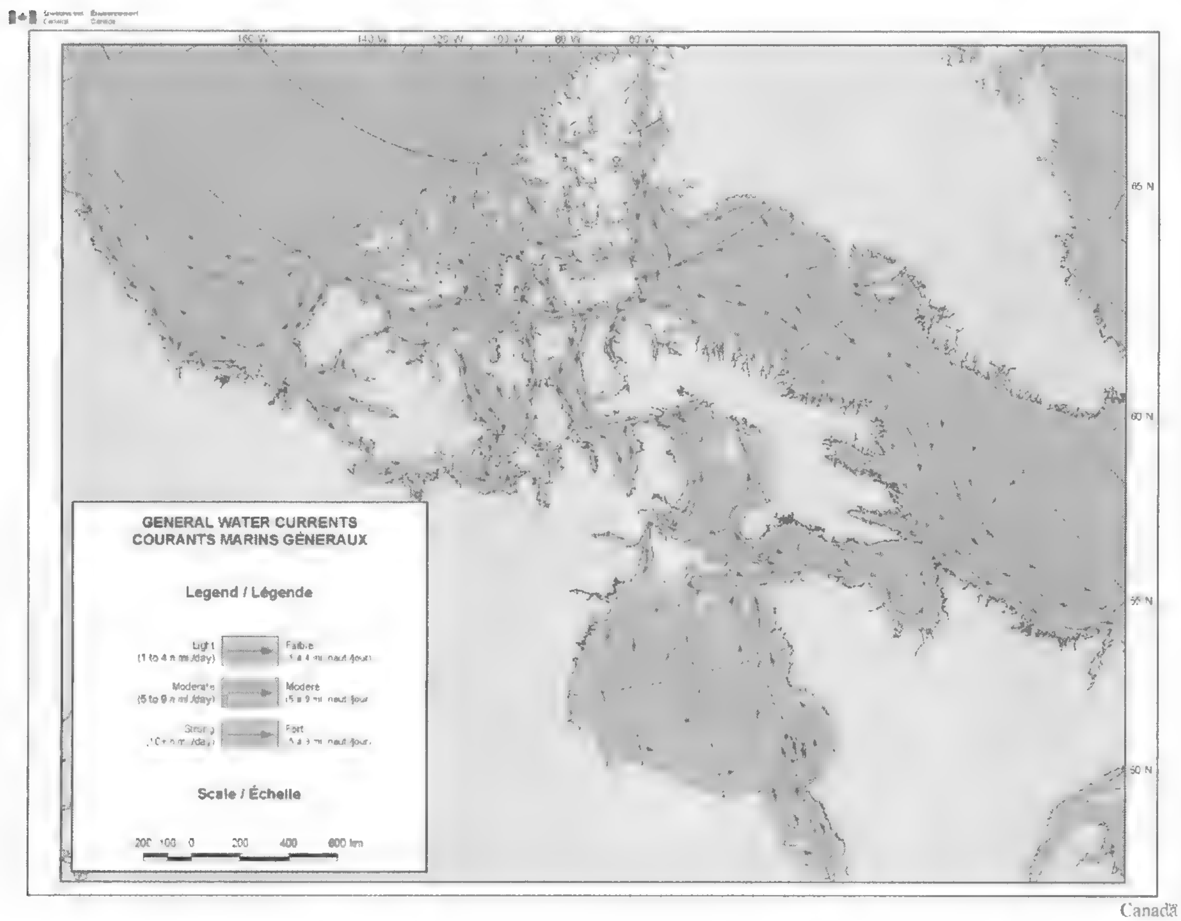

Figure 12 – Currents in area 260.

Tidal currents can reach speeds of 6 kts in Hell Gate and 4 to 5 kts in Cardigan Strait. Southward-flowing tides strengthen when they combine with an outgoing tidal stream over 3 kts, while incoming tides (which flow northward) are usually weak.

Strong tidal streams has been observed in Craig Harbour. Tidal currents flow toward the northwest with the incoming tide and southeast with the outgoing tide in Grise Fiord. Strong currents can occur in the western part of Jones Sound.

Real tides in Lancaster Sound are primarily semi-diurnal. The extreme tidal range at Dundas Harbour is 3.4m, while the mean tidal elevation in some parts of the sound is approximately 1.7 m. Tidal currents near Cape Crauford (at the tip of Brodeur Peninsula) have been measured at speeds of up to 0.8 kt.

A cold surface current (slightly over 2 kts) from the Arctic Ocean flows eastward from Barrow Strait along the southern shore of Lancaster Sound. A relatively warm westward surface current enters Lancaster Sound from Baffin Bay along the northern shore. This intrusive current occasionally carries icebergs from Baffin Bay into the sound, where they eventually sweep back along its southern shore. Surface currents are likely to align with sustained east or west winds due to the confining effect of the shorelines in the sound.

A branch of the eastward-flowing current in Lancaster Sound sets south-southwest into Prince Regent Inlet and then southeast into the Gulf of Boothia. Part of this branch recurves in Prince Regent Inlet, and sets north-northeast along its eastern side. While Bellot Strait is the shortest route to the Northwest Passage, it is renowned for being dangerous and unpredictable. The tidal current in the strait runs at a brisk 8 kts and carries with it any free-moving ice it has grabbed from either entrance. Since it flows in either direction and is highly irregular, the amount of drifting ice that might be encountered at any point along the route is impossible to determine.

The strongest high-tides occur in Admiralty Inlet during a full moon, especially around the summer solstice, with streams as strong as 4 kt. In June, they can initiate the ice-breaking process. Tides and winds affect ice movement, especially in narrow channels such as Adams Sound.

Tidal currents in the sound are strong and can suddenly reverse, causing large chunks of ice to be grounded along its shores. Westerly winds blowing through the sound against the outgoing tide can also create an ice jam that blocks the entrance to Arctic Bay.

Tidal rips have been reported off Holly Cross Point, and navigation can be difficult in Arctic Bay and Adams Sound when westerly or easterly winds oppose the tidal current. The light, southward current that enters Admiralty Inlet from Lancaster Sound can be observed along the western coast of the Inlet. The strong, north-northeastward current that exits the inlet into Lancaster Sound is observed near the coast of Borden Peninsula.

Tides and currents are strong and dynamic in Eclipse Sound. East and west winds can often oppose the tidal currents in the sound. Tidal streams at Pond Inlet set eastward on the outgoing stream and westward on the ingoing stream at a rate about 2 kt.

The permanent, east-flowing current in Fury and Hecla Strait is so strong that any west flowing tidal stream is not always perceptible. In the wider part of the strait, it can vary in direction and often flows across the waterway. The rate of the current is up to 2 kts in this area but much stronger in Labrador Narrows, and 3 kts off Cape Penrhyn (midway along the west coast of Foxe Basin). Tidal currents of up to 7 kts cause dangerous tidal rips in South Passage. Strong tidal rips also occur near Tangle Island, due to an underwater ridge, and off Cape Lily.

3. Maritime Geography

3.1 Coastal Features

SAR Area 260 is made up of Baffin Bay, Parry Channel, Lancaster Sound, Jones Inlet, Admiralty Inlet, the Gulf of Boothia, and the Canadian Arctic Archipelago. At present, less than 10% of Arctic waters are surveyed to modern standards (CHS).

3.1.1 Baffin Bay

Baffin Bay, 689 000 km^2, is a deep body of water located between Greenland and Baffin Island. Water depths are generally less than 1000 m, but reach a maximum 2400 m near its centre. The bay is connected to the Arctic Ocean in the north through Nares Strait, Jones and Lancaster sounds, and to the Labrador Sea in the south by Davis Strait. Discovered by Robert Bylot in 1616, the bay was named after his chief pilot, William Baffin.

Circulation is generally anticlockwise; off Greenland, relatively warm, salty water moves north, while along Baffin Island, cold, fresher water originating from the Arctic Ocean flows south. Icebergs, formed by calving off the Greenland glaciers, appear year-round, but are most numerous in August. Extensive coverage by pack ice occurs seasonally from November to July. At the northern end of the bay is Canada's largest polynya.

3.1.2 Coronation Gulf

Coronation Gulf is a broad indentation in the arctic shore of the territory of Nunavut, roughly the shape of the south coast of Victoria Island, which lies directly north. The gulf receives the Coppermine River, Tree River, Rae River and others and merges with Bathurst Inlet to the east. The small settlement of Kugluktuk lies at the mouth of the Coppermine River.

3.1.3 Dease Strait

Dease Strait is an east-west waterway between the mainland's Kent Peninsula and Victoria Island in Nunavut, Canada. At its eastern end, approximately 12 mi (19 km) wide, is Cambridge Bay; to the west it widens to approximately 38 mi (61 km) and becomes Coronation Gulf. The strait is 100 mi (160 km) long.

3.1.4 Gulf of Boothia

The Gulf of Boothia is entered through Prince Regent Inlet. To the east it is bounded by the northwest coast of Baffin Island, and to the west by the Boothia Peninsula. Depths are generally about 275 m, decreasing southward.

3.1.5 M'Clintock Channel

M'Clintock Channel (also spelled McClintock Channel) is located in the territory of Nunavut, Canada. The channel, an arm of the Arctic Ocean, divides Victoria Island from Prince of Wales Island. The channel is 170 miles (274 km) long, and between 65 to 130 mi (105 to 209 km) wide, making it one of the largest channels in the Canadian Arctic Archipelago.

3.1.6 Parry Channel

Parry Channel is a sea passage running east to west through the arctic islands. Named for explorer W.E. Parry, it begins at Lancaster Sound, passes through Barrow Strait, leads into Viscount Melville Sound, finally reaching the Beaufort Sea through McClure Strait. The permanent pack ice in McClure Strait is an impassable obstacle to further navigation through the Parry Channel, forcing ships making the Northwest Passage to detour far to the south.

The Parry Channel is icebound most years. When it is not, it provides expedited Northwest Passage transiting along windward shores. The narrower Prince of Wales Strait which lies between Banks and Victoria Island is icebound until early September most seasons. The Prince of Wales Straight has been successfully transited, however the route is less popular compared to using the Dolphin and Union strait to the south of Victoria Island where ice conditions are often more favourable.

3.2 Oceanographic Features

SAR Area 260 contains the Canadian Arctic Archipelago. 450cm thick Arctic pack ice and multiyear ice are widespread throughout the area. The archipelago is relatively shallow. The water is typical of Arctic Ocean water, low in temperature and salinity.

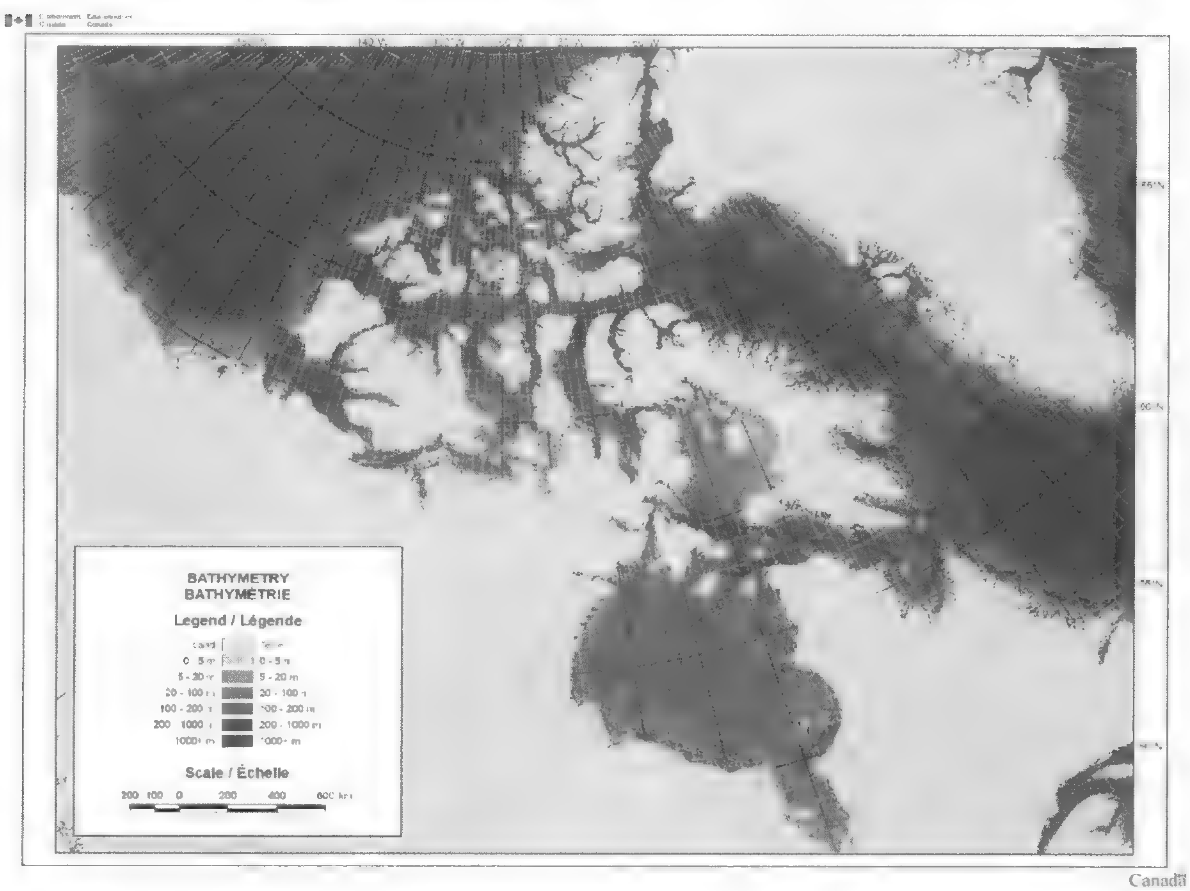

Figure 13 – Bathymetry of SAR Area 260

4. Demographics

4.1 Coastal Population Centres

The regional population is approximately 27000. The most commonly spoken languages are Inuit and English.

The National Pleasure Craft Operator Competency Program reported 472 individuals hold a Pleasure Craft Operator's Card (PCOC) in Nunavut as of 2018-11-08.[5] Proof of competency is not required for mariners in NWT and Nunavut, nor is it required for Inuit and First Nations engaging in subsistence activities, such as fishing.

The Competency of Operators of Pleasure Craft Regulation states;

"(1) These Regulations apply in respect of pleasure craft that are fitted with a motor and that are operated for recreational purposes in Canadian waters, other than the waters of the Northwest Territories and Nunavut. (2) These Regulations do not apply in respect of seaplanes."

Seasonal population variance is of note in Nunavut. SAR Area 260 becomes busier during the summer months. 13 offshore fishing vessels return to Baffin Bay each year, most with a crew of about 30. 11 fuel tankers and 8 merchant cargo vessels with average crew size of 20 begin servicing communities in July and continue through until October. In addition, up to 10 cruise ships enter NORDREG each season with passenger lists from 12 (Hanse Explorer) to 1622 (Crystal Serenity) people on board. Flights over the arctic increase in the summer months.

[5] National Pleasure Craft Competency Program.

4.1.1 Clyde River

Table 4 – Clyde River Details

Population	1053
Location	Population: 1020 IATA airport code: YCY Latitude: 70° 28' 9" (70.4692°) north Longitude: 68° 35' 29.1" (68.5914°) west
Description	Also known as 'Kangiqtugaapik' in Inuktitut, the scenic community of Clyde River is located in the spectacular fiord landscape of the Baffin Mountains along the north-eastern coast of Baffin Island. Clyde has an active tourism industry geared towards the cruise industry and adventure tourism.

Figure 14 – Clyde River

4.1.2 Pond Inlet

Table 5 – Pond Inlet Details

Population	1617
Location	IATA airport code: YIO Latitude: 72° 41' 57.1" (72.6992°) north Longitude: 77° 57' 34.2" (77.9595°) west Elevation: 1 meter (3 feet)
Description	Situated on Eclipse Sound, The picturesque hamlet of Pond Inlet, also called 'Mittimatalik' in Inuktitut after an unknown ancient person presumed to be buried here, is a traditional Inuit community located on the northern tip of Baffin Island near the eastern entrance to the Northwest Passage. The community is a cruise ship hub, a deep water port is currently under construction to accommodate the influx of tourism. Nearby Sirmilik National Park draws research groups, vessels, and additional tourism.

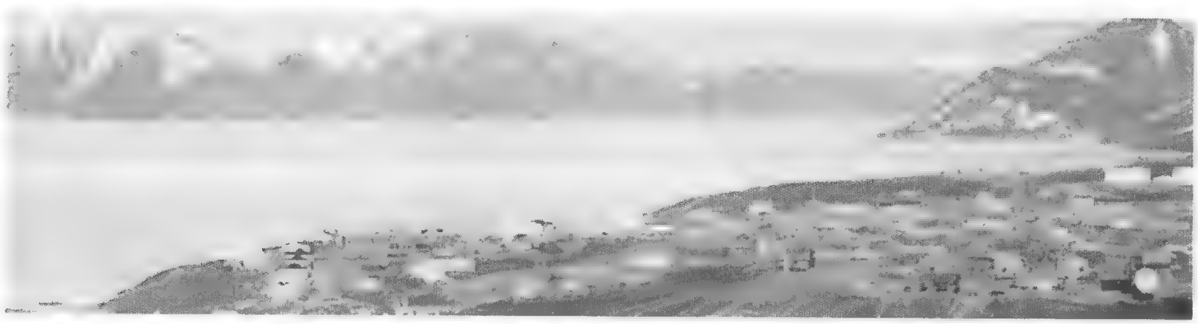

Figure 15 – Pond Inlet

4.1.3 Arctic Bay

Table 6 – Arctic Bay Details

Population	868
Location	Population: 841 IATA airport code: YAB Latitude: 73° 2' 15.1" (73.0375°) north Longitude: 85° 9' 2.1" (85.1506°) west Elevation: 3 meters (10 feet)
Description	Arctic Bay is a vibrant, traditional community located in the northwest corner of Baffin Island. This safe harbour hamlet is situated upon a south-facing gravel beach on Adams Sound, which feeds into Admiralty Inlet, draining northwards to Lancaster Sound and the Northwest Passage. The small community has seen big changes lately with the development surrounding Nanisivik Naval Base to the northeast. A new airport and medical centre have been completed recently. An extension to the existing small craft harbour is in the works which will triple capacity.[6]

Figure 16 – Arctic Bay

[6] As reported by mayor of Arctic Bay during 2019 RAMSARD engagement trip.

4.1.4 Nanisivik

Table 7 – Nanisivik Details

Population	0
Location	Latitude: 73° 2' 12.4" (73.0368°) north Longitude: 84° 32' 5.4" (84.5348°) west Elevation: 130 meters (427 feet)
Description	Nanisivik is a repurposed mine site to be used as a refuelling station for RCN and Coast Guard Arctic operations. The facility is proposed to operate seasonally. It is currently under construction.

Figure 17 – An RCN vessel moored at Nanisivik

4.1.5 Resolute

Table 8 – Resolute Details

Population	198
Location	Latitude: 74° 41' 50.5" (74.6974°) north Longitude: 94° 49' 50.2" (94.8306°) west Elevation: 102 meters (335 feet)
Description	Resolute is known as 'Qausuittuq' in Inuktitut, which means the 'place with no dawn' because of the long winter night this far north. It is also the 'place with no sunset' in the summertime! Resolute is the second most northerly community in Nunavut and Canada. It is sometimes called Resolute Bay, after its bay, the waterway into Parry Channel on the southern coast of Cornwallis Island, right in the middle of the Northwest Passage. Resolute has a brief marine season. It is supplied by sealift once per year and sees occasional visits from research and passenger vessels.

Figure 8 – Resolute Bay

4.1.6 Grise Fiord

Table 9 – Grise Fiord Details

Population	129
Location	Latitude: 76° 25' 6.2" (76.4184°) north Longitude: 82° 53' 40.8" (82.8947°) west
Description	Due to its remote and isolated location near the top of the world, it is a tightly knit community. The airstrip is short, so only medium sized aircrafts can land here, but when visitors arrive they are always welcomed with big smiles. The word 'Grise' is Norwegian for 'pig.' There are no swine here, never were, but the Norwegian explorer Otto Sverdrup named this place 'pig fiord' in 1899 because the loud sounds of walrus herds gathered here reminded him of grunting pigs. The Inuktitut name is more appropriate. It never completely thaws out, even when the sun shines constantly 24 hours a day from April through August.

Figure 19 – Grise Fiord

4.1.7 Kugaaruk

Table 10 – Kugaaruk Details

Population	933
Location	IATA airport code: YBB Latitude: 68° 32' 2.6" (68.5341°) north Longitude: 89° 49' 30.1" (89.825°) west Elevation: 1 meter (3 feet)
Description	'Kugaaruk' means 'little stream' in Inuktitut, the traditional name of the small brook that flows through the village. This place is also sometimes called 'Arviligjuaq' in Inuktitut, which means 'place of many bowhead whales' because it is situated near bowhead habitat. Formerly known as Pelly Bay, the community changed its name to Kugaaruk in 1999. Home to some famous Inuit artists, it's a frequented destination for sea kayaking and whale watching adventures.

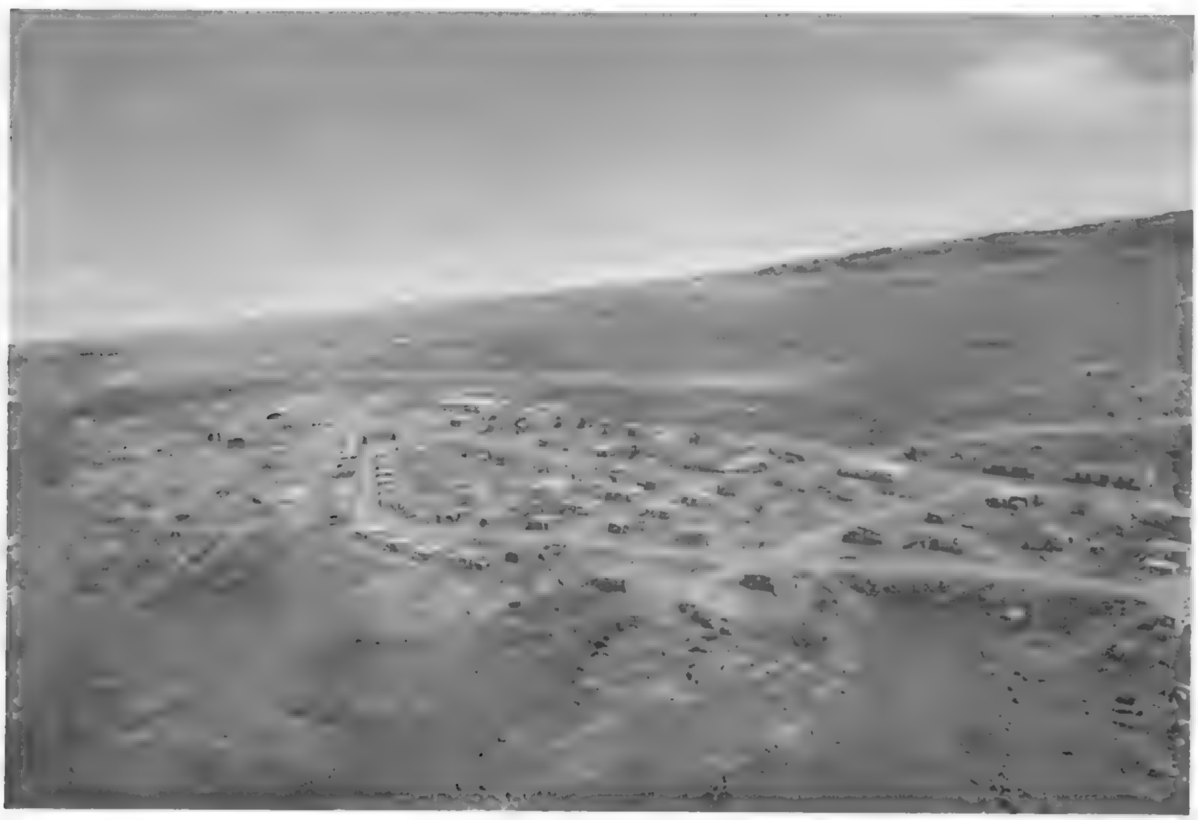

Figure 9 – Kugaaruk

4.1.8 Taloyoak

Table 11 – Taloyoak Details

Population	1029
Location	Latitude: 69° 32' 14" (69.5372°) north Longitude: 93° 31' 16" (93.5211°) west Elevation: 8 meters (26 feet)
Description	Taloyoak is located on the south-western coast of Boothia Peninsula at the Northwest Passage. It is the northernmost community on Canada's mainland. The local people are Netsilik Inuit descendants of the ancient Thule culture. The hamlet name of 'Taloyoak' means 'large caribou hunting blind' in Inuktitut. These screens were built with piled stones along the caribou migration routes. Muskoxen are also found near here and the fishing is some of the best in Nunavut.

Figure 101 – Taloyoak

4.1.9 Gjoa Haven

Table 12 – Gjoa Haven Details

Population	1324
Location	IATA airport code: YHK Latitude: 68° 37' 33.7" (68.626°) north Longitude: 95° 52' 42.1" (95.8784°) west Elevation: 1 meter (3 feet)
Description	The storied community of Gjoa Haven is located on the southeast coast of King William Island at the heart of the Northwest Passage. It is also called 'Uqsuqtuuq' which means 'place of plenty blubber' in Inuktitut. The English name for this place honours the Norwegian explorer Roald Amundsen who wintered here with his ship the Gjøa. He called this place 'the finest little harbour in the world.' In 1906 he was the first European explorer to transit the Northwest Passage. The John Ross expedition of 1829-1833 had previously visited this region and the ill-fated John Franklin expedition of 1845 perished nearby, so Gjoa Haven is often visited by arctic history buffs.

Figure 22 – Gjoa Haven

4.1.10 Cambridge Bay

Table 13 – Cambridge Bay Details

Population	1766
Location	Latitude: 69° 6' 53.6" (69.1149°) north Longitude: 105° 3' 17.4" (105.0548°) west
Description	Cambridge Bay is the centre of government for Kitikmeot, the administrative and transportation hub for this region of Nunavut. It is the largest stop for passenger and research vessels traversing the Northwest Passage. The hamlet is located close to the Ekalluk River, which is famous for giant char. The Ekalluktogmiut people come from there.

Figure 11 – Cambridge Bay

4.1.11 Kugluktuk

Table 14 – Kugluktuk Details

Population	1491
Location	IATA airport code: YCO Latitude: 67° 49' 38.7" (67.8274°) north Longitude: 115° 5' 47.4" (115.0965°) west Elevation: 1 meter (3 feet)
Description	Kugluktuk is the westernmost community in Nunavut. It is located north of the Arctic Circle on the Canadian mainland at the mouth of the Coppermine River where it feeds into Coronation Gulf, which is part of the Northwest Passage. Situated near the border with the Northwest Territories, the scenic valley of the Coppermine River was an ancient source of copper for the Inuit people. It has a unique microclimate that extends a narrow band of stunted boreal forest trees northwards toward the Arctic Ocean. 'Kugluktuk' means 'place of moving water' and the root word 'kugluk' means 'waterfall.' Upriver from this hospitable hamlet is the beautiful Kugluk cascade, also known as Bloody Falls, an ancient fishing and hunting location that is now a territorial park of historic cultural importance

Figure 12 – Kugluktuk

4.1.12 Sanikiluaq

Table 15 – Sanikiluaq Details

Population	882
Location	Latitude: 56° 32' 27.8" (56.5411°) north Longitude: 79° 13' 32.7" (79.2258°) west Elevation: 13 meters (43 feet)
Description	Sanikiluaq is Nunavut's southernmost community, located in the Belcher Islands of southeastern Hudson Bay about 150 kilometres (93 miles) off the coast of Québec. It is the only permanent settlement in this entire archipelago, which is a group of 1,500 islands spread over 3,000 square kilometres (1,158 square miles). Many of the smaller islands provide special breeding grounds for numerous species of migratory seabirds, ducks and geese. The coastal waters contain an abundance of seals, walruses and beluga whales. Expert hunting and fishing is a traditional lifestyle here, as is sea kayaking and soapstone carving.

Figure 25 – Sanikiluaq

4.2 Deep Water Ports

There are several deep water ports under development in SAR Area 260. Nanisivik, an old mine, is now a storage and fuelling site operated jointly by the Royal Canadian Navy and Canadian Coast Guard. Pond Inlet is constructing a deep water wharf to accommodate cruise and cargo vessels.

4.3 Review of Maritime and Economic Activities

Fishing recreationally and for subsistence is widespread in the area. Most small craft are made of metal, with open hull construction. Beaching vessels is a common method of storage. The remainder of small craft are launched using vehicles and trailers.

Figure 26 – Small craft are seen beached

Pleasure craft transiting the northwest passages are rare. Examples exist and such passage making is increasing in popularity. NORDREG reported 3 vessels in 2016, 3 in 2015, 4 in 2014, 7 in 2013, and 10 in 2012. This does not capture vessels which are not required to report to NORDREG due to their size or local transits between communities using small craft. The community of Arctic Bay reported seeing 5-7 per year.

Commercial passenger vessels regularly frequent the area. Cambridge Bay, Pond Inlet, and Kugluktuk are common stop-over locations where cruise ships allow passengers to disembark. Cruise ship itineraries are planned well in advance which aids in resource management for port communities to prepare for the visit.

4.3.1 Ferry Operations

There are no ferry operations in SAR Area 260.

4.3.2 Commercial Fishing

Commercial fishing occurs in Davis Strait adjacent to Clyde River in late summer. See RAMSARD NORDREG Fishing Study for details on fleet size, trends, and characteristics.

4.3.3 Recreational Fishing & Boating

Many people in the region fish. Due to Inuit traditions, food insecurity, and high unemployment; fishing is rarely done recreationally by locals. Guides and outfitting companies exist in every community which offer fishing trips to visitors and tourists.

4.3.4 First Nations Maritime Activities

Inuit in SAR Area 260 maintain a close relationship with the geography in which they live. "Harvesting" is the general term used to describe the act of hunting, trapping, gathering, and fishing in Northern communities. Harvesting activities are very popular in part due to the remoteness of arctic communities.

Most non-commercial vessels used for recreation and subsistence fishing are 26' LOA or less.

4.4.5 Eco-tourism Operations

All communities operate one or more outfitters which typically offer professional guides, vessels, snowmobiles, clothing, hunting, fishing, and camping equipment. Popular marine activities include;

- Whale watching
- Seal and seabird wildlife tours
- Fishing
- Iceberg viewing
- Guided expeditions to whaling camps
- Scenic boat trips between communities

4.4.6 Commercial Cargo Operations

INNAV data was compiled for vessels operating in the NORDREG zone from 2012 – 2016. Any vessel which made 3 or more port visits in NORDREG during this time have been included in this list. A search was run for each vessel via the Transportation Safety Board of Canada (TSBC) database from 1991 – 2019. Wherever a vessel has been involved in a TSBC marine investigation, a brief summary is provided.

The following vessels are known to conduct tug operations in NORDREG.

Table 16 – Vessels conducting tug operations in NORDREG

Tug Vessel:	LOA (m)	Transportation Safety Board of Canada Remarks
Alex Gordon	63	No marine investigation reports exist for this cohort of vessels from 1991 – 2019.
Bert Long	21	
Bob's Welding 1	14	
Edgar Kotokak	47	
Fathom Wave	19	
Henry Christoffersen	47	
Island Tugger	36	
Jim Kilabuk	63	
Kelly Ovayuak	45	
Nunakput	52	
Pisurayak Kootook	49	
Risco Reegan	20	
Vic Ingraham	47	
W.H. Horton	18	

The following list of merchant vessels are known to regularly transit though NORDREG.

Table 17 – Merchant vessels transiting through NORDREG

Merchant Tankers:	LOA (m)	Transportation Safety Board of Canada Remarks
Alsterstern	161	No investigations
Dara Desgagnes	124	No investigations
Espada Desgagnes	228	No investigations
Havelstern	161	No investigations
Jana Desgagnes	123	No investigations
Maria Desgagnes	120	On 12 September 2005, Maria Desgagnes collided with Sailing vessel El Tio in the St. Lawrence River.
Nanny	116	Ran aground October 25 2012 while outbound from Baker Lake, NU damaging forward section of hull. Refloated Oct 27 and proceeded to St. John's, NFLD for repairs. No injuries or pollution reported. Nanny ran aground a second time on Oct 14, 2014 near Chesterfield Inlet.
Sarah Desgagnes	147	No investigations
Travestern	161	No investigations
Uvaq	164	No investigations
Ugale	195	No investigations
Merchant General:		
Anna	173	On 29 Aug 2017; Vessel lost power and subsequently ran

		aground near Beauharnois, Quebec.
Avataq	113	No investigations
Claude A Desgagnes	138	On 6 Nov 2013, struck the approach wall of Iroquois Lock in St. Lawrence Seaway. Subsequently, the vessel ran aground. No pollution or injuries reported, the ship sustained minor damage.
Mitiq	136	No investigations
Qamutik	136	No investigations
Rosaire A. Desgagnes	138	No investigations
Sedna Desgagnes	139	No investigations
Umiavut	113	No investigations
Zelada Desgagnes	138	No investigations

4.4.7 Cruise Ship Operations

Table 18 – Cruise Ship Operations

Merchant Passenger	LOA (m)	Transportation Safety Board of Canada Remarks
Akademik Ioffe	117	Under investigation due to running aground in 2018.
Bremen	111	No investigations
Crystal Serenity	250	No investigations
Hanse Explorer	47	No investigations
Hanseatic	123	On 29 August 1996, ran aground in Simpson Straight, NWT.
KAPITAN KHLEBNIKOV	129	No investigations
L'Austral	142	No investigations
Le Boreal	142	No investigations
Le Soleal	142	No investigations
NatGeo Explorer	112	No investigations
Ocean Endeavour	137	No investigations
Sea Adventurer	100	No investigations
Sea Explorer I	90	No investigations
Silver Explorer	108	No investigations
The World	196	No investigations

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Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

2018-19 Maritime Search and Rescue Arctic Analysis (Area 260)

Canada

Record of Amendments

#	Date	Description	Initials

Approvals

JEAN-SÉBASTIEN LANDRY AND JAMES HARE REGIONAL RAMSARD ANALYST	Recommended : JSL JH Date: 18/03/2019
STEVE THOMPSON DEPUTY SUPERINTENDENT, ARCTIC OPERATIONS	Approved : Date: 18-Mar-2018
PETER GARAPICK SUPERINTENDENT, ARCTIC OPERATIONS	Approved : (S. Thompson for) Date: 18-Mar-2018
NEIL O'ROURKE ASSISTANT COMMISSIONER, ARCTIC REGION	Approved : Date:
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JULIE GASCON DIRECTOR GENERAL, OPERATIONS	Approved : Date:
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#	RISK	RECOMMENDATIONS
	SAR AREA 260	
1.	**LACK OF SECONDARY SAR IN ACTIVE MARINE COMMUNITIES** **Pond Inlet (n=8), Gjoa Haven (n=7), Arctic Bay (n=5), Naujaat (n=1), and Clyde River (n=1)** are respectively the most active Arctic communities of SAR Area 260 from 2012 to 2016 - Taloyoak and Gjoa Haven have regular small craft transiting - Pond Inlet and Arctic Bay have regular small craft transiting There's been no CCGA involvement in any SAR cases in Area 260 from 2012 to 2016.	• Focus the implementation of CCGA in these communities
2.	**HIGH POTENTIAL OF SMALL CRAFT TRAFFIC BETWEEN COMMUNITIES DURING THE SUMMER** • Small craft regularly transit 300 – 400 nm between communities along exposed shorelines	• Continue the implementation of CCGA units in Arctic communities through the OPP's CCGA Expansion and Community Boat initiatives • Increase the presence of Coast Guard SAR training officers in the Arctic • Increase the safety culture by leveraging CCGA presence via regional Boating Safety MOU with Transport Canada

3.	**LIMITED BOATING SAFETY / SAR INCIDENT MANAGEMENT STRATEGY IN THE ARCTIC** • Poor survival time of mariners in distress due to cold water • Elders and CCGA personnel reported young people are being irresponsible while boating – taking on higher risk, departing in poorer weather • Limited charts available in local communities for SAR planning	• Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly territorial governments • Sign regional MOU with Transport Canada to increase boating safety culture by leveraging CCGA • Recruit young people into CCGA, provide communities/hamlet offices an outlet to receive updates from JRCC during incidents • Fund Canadian Safe Boating Council campaigns such as Operation Life Preserver. Provide boater education on the effects of cold water, HELP position, and distribute life jackets and floater suits • Recommend expansion of the mandate of Canadian Safe Boating Council's Operation Life Preserver to include floater suits for northern mariners. • Distribute buoyancy tanks for installation in small craft so they do not sink when swamped/ capsized. • Chart to modern standards all small-craft navigable waters within 75 nautical miles of populated areas • MOU agreement between the Coast Guard and the Canadian Hydrographic Survey Resource for Arctic SAR Team to use charts as engagement gifts. They are more cost-effective than most options and far more sought-after by communities

4.	**HIGH RISK GROUNDING FROM PASSENGER VESSELS** • For passenger vessels, the most common issues are running aground due to poor navigation or charting. Examples include Clipper Adventurer (197 POB) in 2010, and Akademik Ioffe (162 POB) in 2018. • Russian Charts of the Canadian Arctic are considered more useful than Canadian Hydrographic Service resources • Recent ice conditions opens unexplored areas	• Chart all navigable waters within 200 nautical miles of populated areas • Improve or increase Canadian Hydrographic Survey Resources • Implementation of the Low Impact Shipping Corridors initiative. • Increase Coast Guard presence in the Arctic
5.	**COAST GUARD IS NOT ALWAYS NOTIFIED OF MARINE SAR CASES** • Many SAR incidents go unreported in the North • MCTS Iqaluit is not yet adjusted on instant communication for SAR incidents • Confirmation bias exists in SAR reporting: locals will only call government for help if they know the government is nearby • JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.	• Link Iqaluit MCTS services to community towers to offer services. It is recommended that steps be taken to allow MCTS Iqaluit to monitor community VHF towers for offering services such as sail plans, weather, issuing MARB's, and coordinating searches with JRCC. • Provide communities (via Hunters and Trappers Associations / Organizations) with loanable AIS/InReach/SPOT devices to minimize search time • Increase public awareness of JRCC and the SAR system (i.e., who to call, how it works) • During SAR incidents, provide communities / hamlet offices an outlet to receive updates from JRCC • Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly the territorial government

6.	**JRCC and MCTS – Lack of environmental data**	• Provide the Rescue Coordination Centre with data to account on ice drifts and characteristics when planning for searches.
7.	**JRCC and MCTS – Lack of position finding capability** • VHF in Arctic is not equipped with RDF • No Cellular GPS Positioning Capabilities	• Increase MCTS RDF capabilities • Provide small craft with loanable AIS/InReach/SPOT devices to minimize search time • Provide JRCC general locations of cabins on shore, used by locals in the event of adverse weather conditions
8.	**JRCC and MCTS – Lack of Inuktitut Speaker / Operator** • Large number of Inuktitut only speaking mariners, difficulty for locals to communicate with JRCC and MCTS	• Ensure 1 MCTS member can translate Inuktitut to English • Ensure timely access to Inuktitut interpretation services in interim
9.	**IMPACT OF COMMERCIAL ACTIVITIES ON HARVESTING AREAS** • Hunters travel further away from communities in order to harvest marine wildlife whenever commercial vessels are in the vicinity	• Complete a study commercial vessel transit patterns and restriction possibilities. For example, limit cruise, cargo, ore, and merchant traffic to entering and exiting only one side of Eclipse Sound.

2. Arctic SAR Area 260 Summary

In summary, the Canadian Coast Guard achieved its Performance Standard in SAR Area 260 in all five years under review (2012-2016).

Figure 1: Regions of risks identified in SAR Area 260

However, maritime risks still exists. To reduce the risks of a Search and Rescue incidents occurring in SAR Area 260, the mitigation measures presented at the beginning of this report are strongly recommended.

For that reason, after completing a thorough analysis of Area 260 the analysis team has come to the conclusion that:

<u>A situation exists that requires immediate action.</u>

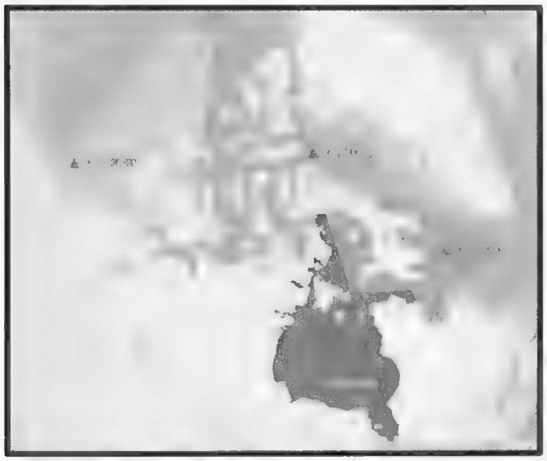
To mitigate the risk of injuries and lives lost due to marine SAR incidents, the recommendations in this report the team has chosen to highlight for further considerations are:

1. The continuation of CCGA implementation in Arctic communities
2. The establishment of a SAR prevention strategy adapted for northern climates
3. The establishment of an IRB station in Pond Inlet

If implemented, the analysis team has concluded that the level of risk to the Coast Guard with regards to SAR delivery will be lowered and the Coast Guard Performance Standard results will improve.

3. Introduction

Due to the limited scope but large area under study – 50 % of the coastline of the country – this study did not have the intention to focus on regionally-specific challenges, like specific shipping channel navigational risks, specific implications of SAR in ice-breaking operations, or Arctic Mass-Rescue Scenarios, which are already taken care by Subject Matter Experts (SME). For this reason, the readers of this report should also consult experts at the Maritime Communications and Traffic Services Centre in Iqaluit, the Regional Operation Centre in Montreal, the Joint Rescue Coordination Centres in Trenton and Halifax, and Subject Matter Experts on Mass Rescue prior of making decisions affecting their Arctic operations.



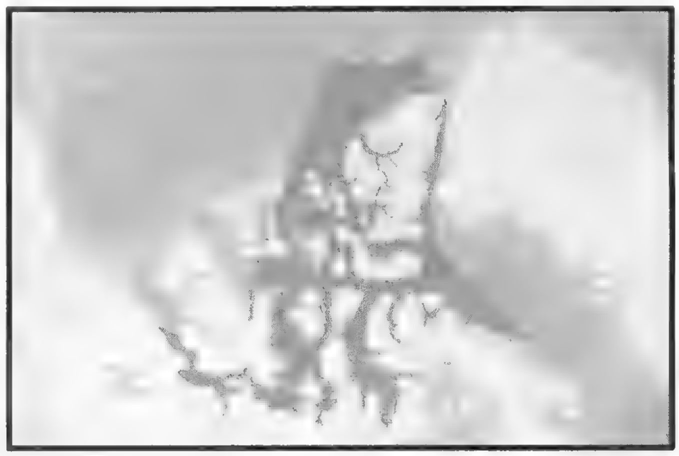


Figure 2 and 3: Map of SAR Areas under review and Map of SAR Area 260

Areas 259, 260 and 155 are served by Joint Rescue Coordination Centre (JRCC) Trenton for coordination of maritime search and rescue (SAR). Area 010 is served by JRCC Halifax.

This document is a risk-based analysis of maritime SAR delivery in SAR Area 260 using data from 2012-2016. The purpose of this report is to identify the need for Coast Guard SAR assets using historical incident data and SAR partner engagement. Current SAR delivery will be assessed using the Canadian Coast Guard SAR Performance Standard.

SAR Area 260 encompasses all land and water areas of the Nunavut except Baffin Island from 70°N Southward and 64°W Eastward. The regional population is approximately 27,000. The most commonly spoken languages are Inuit and English. Islands in Hudson and James Bay are included as lands of Nunavut and part of SAR Area 260. All details concerning wind, ice, tides, commercial and local maritime activities, and more, can be found in our environmental scan at **Annex D.**

Throughout the report, the analysis team started with an overview of the SAR Area, followed by a review of SAR incident data from the Coast Guard's System of Information on Search and Rescue (SISAR). This is followed by a summary of SAR engagement, and a section on primary SAR vessels and SAR incident response characteristics in relation to the Coast Guard Performance Standard for SAR.

4. Incident Data Review and Analysis – SISAR

As per the Canadian Aeronautical and Maritime Search and Rescue (CAMSAR) manual, the definitions of the classifications of Marine Cases are as follows:

- ***M1 - Distress*** – *A person or persons from a vessel are threatened by grave and imminent danger and require immediate assistance.*
- ***M1P - Distress Reported After the Fact*** – *An M1 case that has been resolved but would have required a response had the SAR system been alerted at the time of the case.*
- ***M2 - Potential Distress*** – *The potential exists for an M1 case if timely action is not taken; i.e., immediate response is required to stabilize a situation in order to prevent distress.*
- ***M3*** *- A maritime situation other than an M1 or M2 case, where assistance is rendered to prevent case degradation to greater potential danger.*

4.1. Incidents Analysis – M1 to M3

In Area 260 from 2012 - 2016 there were a few SAR incidents involving commercial vessels. There were two medevacs, one grounding of a research vessel, and the extraction of a film crew (4 jet skis and a support vessel). In SAR Area 260, 28 SAR calls were for disabled, overdue, stranded or grounded pleasure craft, which represented 89 % of all M1 to M3 cases.

Pleasure crafts in these incidents ranged from small canoes to a 44-foot schooner. SAR Cases near Pond Inlet (n=8) and Gjoa Haven (n=7) were the most common for the analysis period, the latest including a SAR case involving a transit between Taloyoak and Gjoa Haven. The third busiest location was Arctic Bay (n=5). Finally, one case also occurred in Naujaat, Clyde River and in Bellot Strait (44-ft schooner aground). Finally, two cases were in the Northwest Passages (sailing vessel aground), more specifically the Queen Maud Golf.

According to JRCC Trenton, there is sizeable traffic in the corridor between Taloyoak and Gjoa Haven. The two communities seem to be linked, with a lot of families travelling back and forth in a high-risk area due to the open seas. During our engagement sessions, we confirmed travel between communities is a common occurrence in the Arctic, especially when communities are in proximity to one another.

Figure 4: Incidents by Activity for SAR Area 260

Another high-risk area according to JRCC Trenton is between the communities of Pond Inlet and Arctic Bay, with marine SAR cases occurring at least once per year.

4.2. Alerting Method

Within SAR Area 260, EMO Nunavut (41%) is most often alerted first, followed by JRCC Trenton (31%).

For the period examined, SAR Area 260 had three SAR cases involving a commercial vessel and 25 SAR cases involving a pleasure craft. JRCC was alerted first for all SAR cases involving commercial vessel.

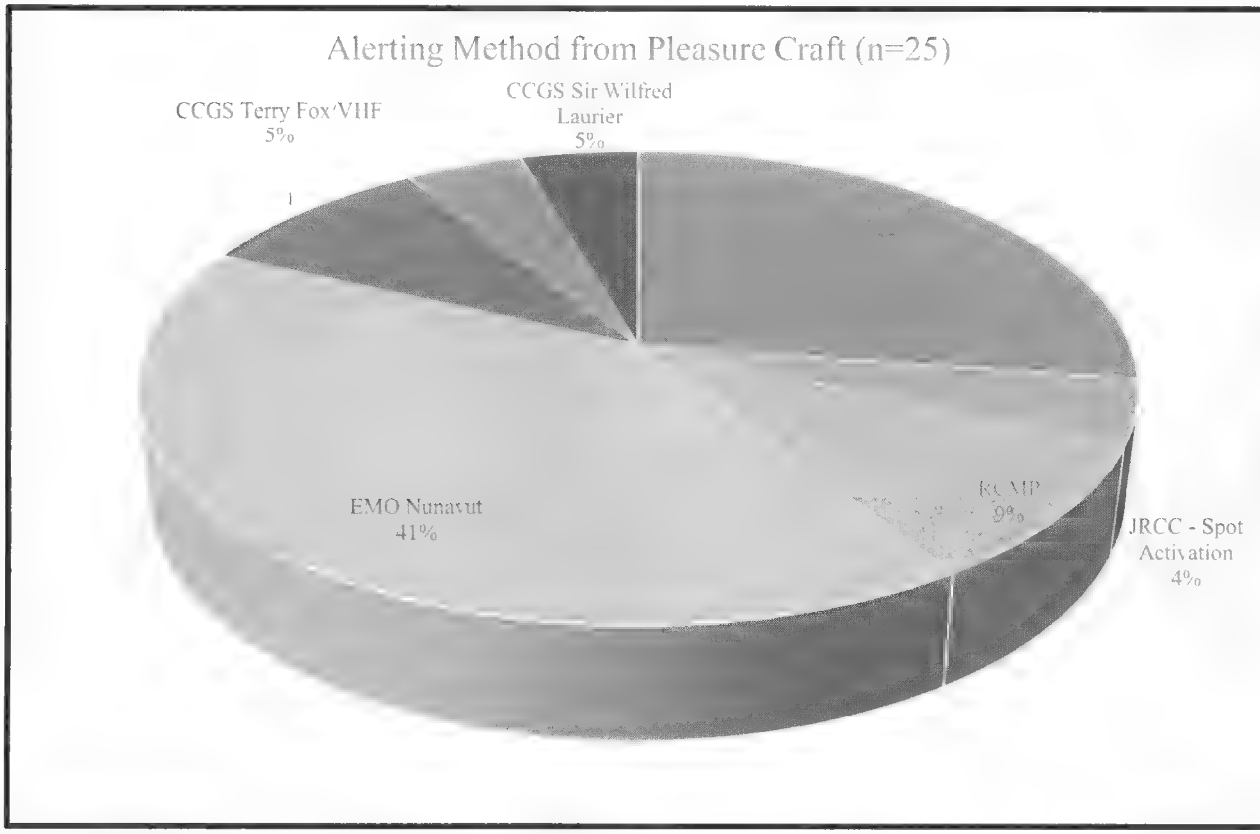


Figure 5: Alerting Method from Pleasure Craft

4.3. *Monthly Distribution M1 Cases*

Figure 6 shows an overall picture of M1 cases that have occurred in SAR Areas 259, 260, 155 and 010. The results are generalized for the entire Arctic due to small data sets from individual SAR areas. SAR Area 260 had one M1 case; an overdue vessel.

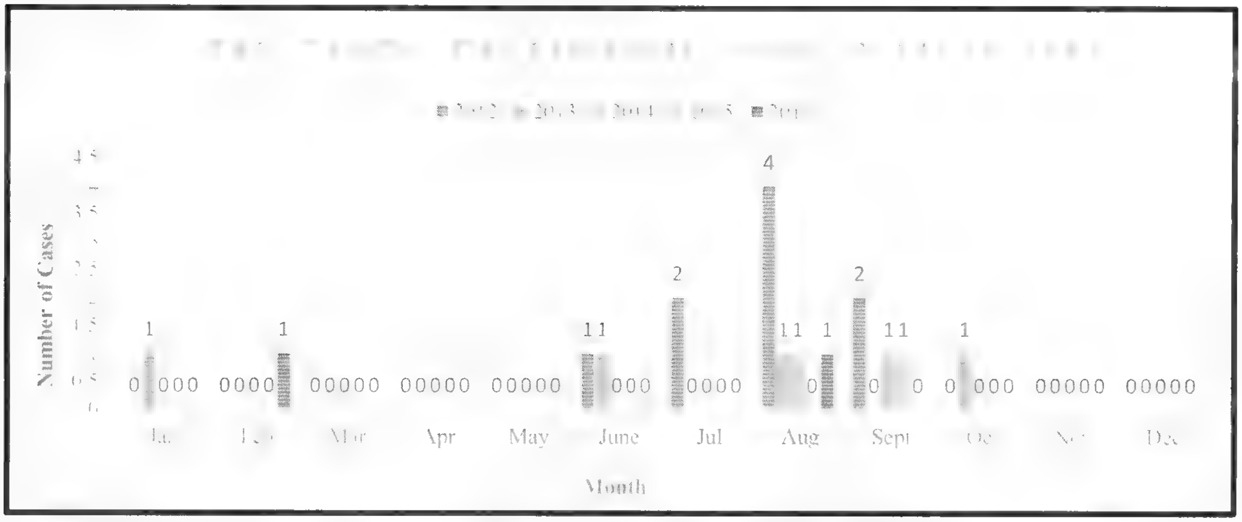


Figure 6: M1 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.4. *Monthly Distribution M2 Cases*

Figure 7 shows an overall picture of M2 cases that have occurred in SAR Areas 259, 260, 155 and 010. July (n=10), August (n=11) and September (n=9) saw the greatest number of M2 cases. Throughout the period examined, there were no M2 cases reported from December to May.

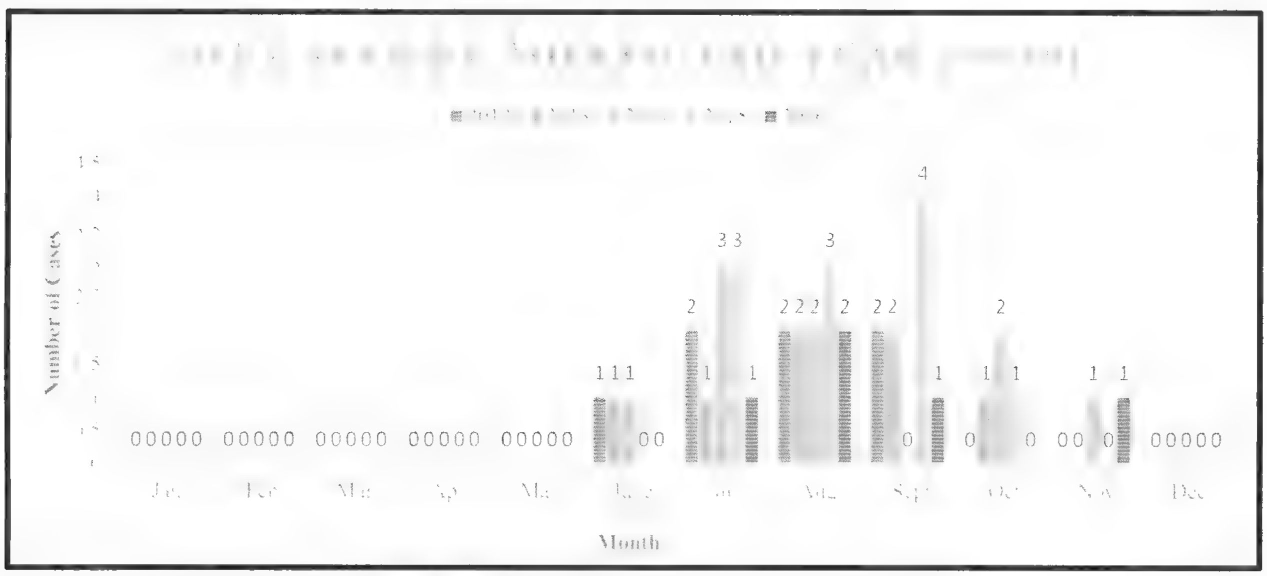


Figure 7: M2 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.5. Monthly Distribution M3 Cases

Figure 8 shows an overall picture of M3 cases that have occurred in SAR Areas 259, 260, 155 and 010.

The greatest number of M3 incidents occurred in August. M3 cases peak during the summer months with incidents extending earlier and later into the shoulder seasons, respectively.

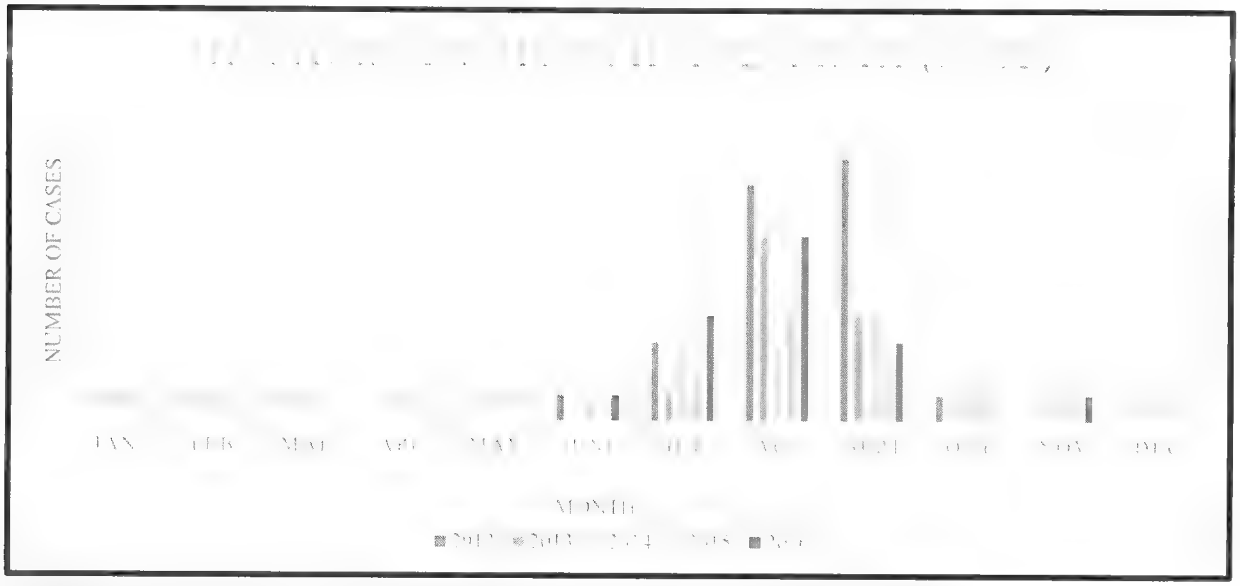


Figure 8: M3 SAR Cases by Month and Year for SAR Areas 259/260/155/010

5. Distribution of M1, M2 and M3 SAR Cases

From 2012-2016; 18 x M1, 39 x M2 and 75 x M3 cases were reported to JRCC **for SAR Areas 259/260/155/010** combined.

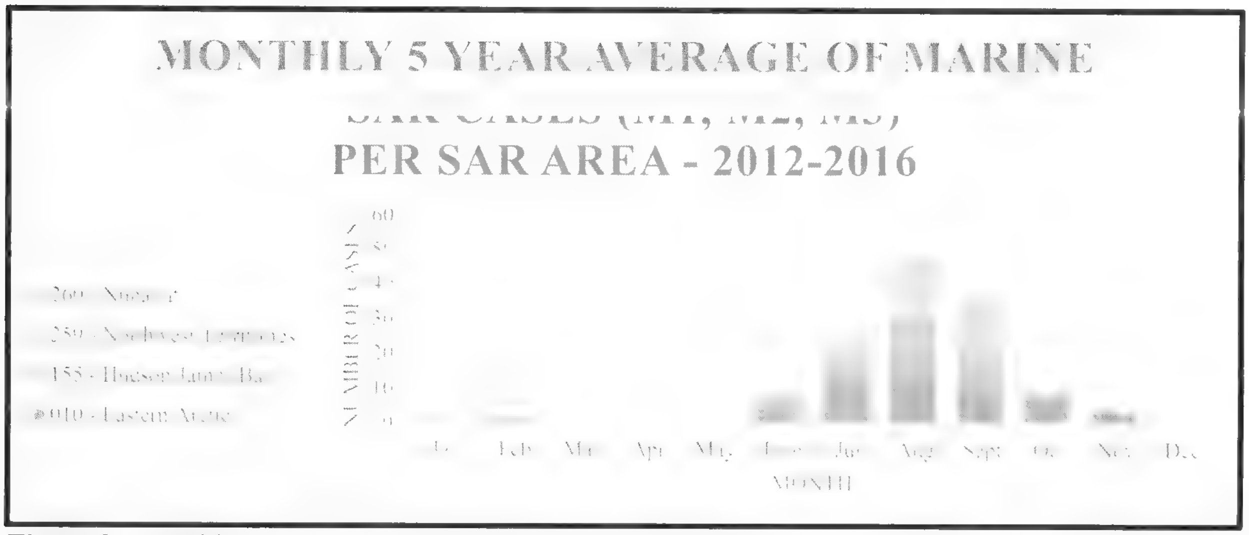


Figure 9: Monthly Five-Year Average of Marine SAR Cases (M1, M2, M3) by SAR Area for SAR Areas 259/260/155/010

The month with the highest average number of marine case for SAR Area 260 is September due to the high volume of seasonal pleasure craft and commercial traffic. Small craft can be found on the water at any time of year. If open water exists, Inuit are likely engaged in harvesting activities. A November 2016 example of an M2 case was a local vessel overdue from a hunting expedition. Late summer is when M1 to M3 cases peak in volume.

SAR Area 260 had <u>28</u> SAR cases during the 5-year period of study.

Table 1: Number of cases per community in SAR Area 260 (5-year period)

SAR Area	Number of communities	Number of cases	Total average (cases/community)
260	13	28	2.15

Through SAR partner engagement; it was identified that SAR statistics are underreported and the SAR case values presented in SISAR databases **do not capture all marine incidents**. From community engagement sessions; it was estimated that **the *actual* number of SAR cases that occur annually is <u>4-5 incidents per community</u>**. In SAR area 260, this represents between 9.29 to 11.61 times as many incidents occurring as are reported. Without providing a number, JRCC relayed the same picture of SAR underreporting. Wherever assets are not available, the federal SAR system is not activated, thus presenting as if such an area has no need for SAR resources.

It was pointed out during our engagement sessions that each time the local SAR vessel is utilized in a community, it might not be to respond as what Coast Guard would classify as a M1, M2, or M3 case. As an example, sometimes a community will ask their local marine SAR unit to bring kids on a traditional camp instead of using smaller vessels from the community to ensure safe passage. Tasking authorization for these type of SAR-prevention cases might be confusing. For locals it could equally be hard to understand why such request might be refused by a primary SAR asset.

6. Risk Matrix – Based on Five Years of Historical Data – 2012 to 2016

The risk portrayed in Figure 10 has been calculated using historical SISAR data from 2012 to 2016.

The criteria for determining how each category would be placed in the risk matrix (likelihood and impact) can be found in Tables 2 and 3.

Table 2 and 3 – Risk Matrix Likelihood Criteria and Risk Matrix Impact Criteria

Likelihood Legend		Range for likelihood number
Almost Certain	1 incident or more per week	52+
Likely	1 or more incident per month	**11 to 51**
Moderate	1 or more incident per year	**1 to 11**
Unlikely	1 incident every 10 years	**0.1 to 0.9**
Rare	1 incident every 25 years or more	**0.04 to 0.09**

Impact Legend	
Extreme	More than 50 at risk in incident.
High	More than 10 lives at risk in incident.
Moderate	More than 5 lives at risk in incident.
Low	One to five lives at risk in incident.
Negligible	No lives at risk in incident.

Impact					
Extreme					
High					
Moderate					
Low		M1 Commercial M2 Commercial	M1 Pleasure M2 Pleasure		
Negligible			M3 Commercial	M3 Pleasure	
	Rare	Unlikely	Moderate	Likely	Almost Certain
	Likelihood				

Figure 10: Risk Matrix – Area 260

Overall, commercial vessels were found to have a low risk in SAR area 260. Well planned sealifts, well prepared and knowledgeable crew, and the overall industry safety culture are all factors which make vessels carrying goods to communities relatively safe.

However, SAR Area 260 is also the busiest Arctic SAR Area for passenger vessels, since most will spend the majority of their trip within Area 260 as part of the Northwest Passage. As an example, Cambridge Bay and Pond Inlet are common stopover locations where cruise ships allow passengers to disembark.

Pleasure craft (including those used for harvesting) can be found in large quantities in every community. Due to the volume of small craft traffic that Area 260 sees every season, the likelihood of an incident occurring is relatively high. The impact of pleasure craft incidents are low, due to the number of people on board such a vessel. Low impact is defined as 1-5 lives at risk during an incident as per Table 3. Factors affecting the likelihood of a small craft incident are the level of boater education and the number of boaters within a community. Population growth in the Arctic coupled with a general minimal level of SAR system knowledge corresponds to an increased need for SAR assets. This is due to an increased likelihood of an incident occurring, as per the matrix in Figure 10. Well-informed boaters make smarter choices and are more likely to avoid hazardous situations altogether.

7. Asset Response in Incident Resolution – (M1 to M3)

In the Arctic, multiple assets are tasked at the same time. During the same SAR case, assets can also have multiple sorties due to refueling. The table below represents the number of times an asset was tasked for all SAR cases examined.

Multiple sorties or responding assets for the same SAR case are shown by the table below.

Table 2: Resources Tasked in SAR Area 260 (n=28)

Unit Tasked	*Number of Time Tasked*	*Source*
N/A	0	Primary Maritime SAR
Total	***0***	
CCG Ship Opportunity	20	Secondary Maritime SAR
Federal Vessel	1	
Total	***21***	
CCGA	0	Other - Maritime
VOO Fishing	0	
VOO Commercial	0	
VOO Pleasure	10	
Provincial Vessel	0	
Total	***10***	
CORM	1	Primary Air SAR
GRIF	0	
HERC	18	
Total	***19***	
Various CF Air	2	Secondary Air SAR
CCG Air Opportunity	19	
Federal Aircraft	8	
Total	***29***	
CASARA	1	Other - Air
AOO Commercial	12	
Private Aircraft	0	
Total	***13***	
Grand Total	***92***	

In SAR Area 260, the far distance between the central Nunavut and Trenton, Ontario or Winnipeg, Manitoba, makes it difficult for Primary Air assets to arrive on scene in short notice. For SAR Area 260, the Hercules airplane has a reaction (wheels up) time of 30 minutes 40 hours per week, and a 2-hour reaction time otherwise. The endurance for a Hercules airplane is 7 hours (up to 11 hours given loading and fuel considerations) while the endurance for a Griffon helicopter is 2-3 hours, which makes it virtually impossible to reach SAR Area 260. In fact, Griffon Helicopters are rarely tasked north of James Bay. Along with Primary Air, other assets are often tasked for the same SAR case. Precisely, from 2012 to 2016, assets were tasked 92 times for a total of 33 cases, for an average of approximately 3 assets per SAR call.

While looking at the table above, we notice a high volume of vessels of opportunity (VOO). That is for us a concern since maritime SAR delivery in the Arctic has an element of luck that seems to be too often counted on. While Air Primary response is reliable, it is important to take into account the total response time (reaction and on route time) in incident resolution.

Figure 11: SAR Area 260 Incidents Locations

The following is a graphic depiction of the incident locations for SAR Area 260.

8. Upcoming Arctic SAR Assets

From our SISAR database, we were able to categorize the busiest communities in the Arctic that might require enhanced SAR response options such as CCGA. Highlighted in green represents the communities with an operational CCGA as of February 2019. Highlighted in yellow represents the communities where the creation of a CCGA unit by the end of 2019 has been proposed. In SAR Area 260, three SAR cases involved commercial vessels, all medevacs, which leaves a total of 25 SAR cases involving pleasure crafts. Below is a table classifying the busiest communities.

Table 3: Number of calls per community with current or upcoming Arctic SAR assets – SAR Area 260

Area 260 (n=25)
Pond Inlet (8)
[redacted] (7)
Arctic Bay (5)
Naujaat (1)
[redacted] (1)
Bellot Strait (1)
Queen Maud Golf (2)

Although limited data exists in the Arctic, **Table 5** includes a summary of M1 cases, with JRCC being aware 83.33 % of the time for all M1 SAR cases. The following provides a summary of the cases in order

to understand what locations present the highest demand in maritime SAR for the Arctic. Below is the breakdown for M1 incidents – in bold being communities in SAR Area 260.

Table 4: M1 Incidents by Type

Vessel Type	Fishing vessel	Commercial	Pleasure craft
M1 - Arctic	3	3	12

Out of the 12 cases involving a pleasure craft from 2012 to 2016, the location were the following:

1. **Pond Inlet (Nunavut)**
2. Tuktoyaktuk (NWT)
3. Ungava Bay (community unknown)
4. Foxe Basin (communities of Hall Beach, Cape Dorset, Naujaat and Coral Harbour)
5. Moosonee (James Bay Area)
6. Gillam (Manitoba)
7. Puvirnituq (Nunavik)
8. Churchill (Manitoba)
9. Iqaluit (Nunavut)
10. Igloolik (Nunavut)
11. Pangnirtung (Nunavut)
12. Cape Dorset (Nunavut)

Out of these 12 communities, only three currently have a CCGA unit (Pangnirtung, Tuktoyaktuk, and Churchill) that is able to respond. Yet, all of these cases could have been responded to by a well-trained CCGA unit. Two incidents are categorized as 'other' (1 SPOT activation resulting in chartered helicopter extraction and 1 out of fuel vessel resulted in POB transported back by the CCGS Eckaloo).

Figure 12: M1 Incidents Involving Pleasure Craft from 2012 to 2016

In sum, this breakdown reinforced the argument for CCGA Central & Arctic Inc. to continue the establishment of CCGA units in Pond Inlet and Arctic Bay.

9. Engagement with SAR Partners

SAR Operations Officers met with JRCC Trenton and Halifax, the Regional Operational Centre in Montreal, MCTS Iqaluit, and attended Mass Rescue Operations Workshops with numerous Arctic SAR partners and stakeholders to verify research findings. For SAR Area 260, engagement sessions were held in Pond Inlet, Arctic Bay, and Taloyoak to identify shared local hazards and boating trends.

Since Pond Inlet (n=8) and Arctic Bay (n=5) have a similar number of SAR cases, further results from engagement sessions are used to determine priority in SAR assets implementation. In this case, we're evaluating which community, Pond Inlet or Arctic Bay, should be considered for a Northern IRB station.

Of note Pond Inlet Elders explained to the Coast Guard in January 2019 how a ***slow response time*** has resulted in the death of 2 young men in 2000 after a vessel capsized. Furthermore, we learned SONAR use of commercial vessels approaching Pond Inlet scares whales away – forcing community members to ***travel greater distances*** by boat to harvest them. Third, we learned travels between Pond Inlet and Arctic Bay using small craft is well established (approx. 210 nautical miles). Pond Inlet is, however, perceived by locals as being ***6 times more active*** than Arctic Bay. Specifically, Pond Inlet estimates 300 boats locally while Arctic Bay only estimates 50. Finally, hunting/shelter cabin locations (identified in red) are considerably more prevalent in Pond Inlet than in Arctic Bay.

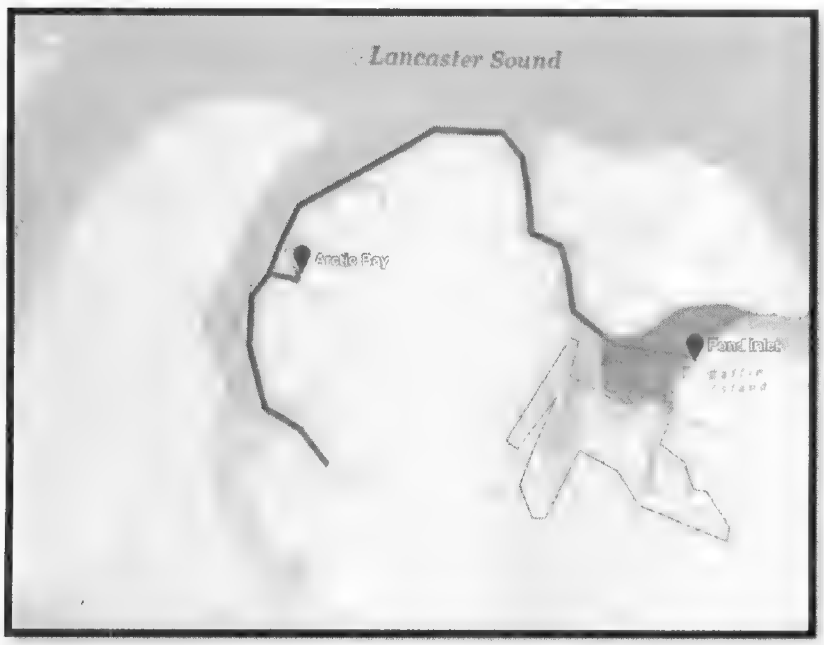


Figure 13: Engagement results from Arctic Bay and Pond Inlet

The initial hypothesis was the maritime activity in Arctic Bay could be enough to advise implementing a Northern Inshore Rescue Boat Station; however, given these engagement session results, it seems Arctic Bay has limited challenges compared to Pond Inlet. In fact, it seems clear Pond Inlet requires a faster response time and higher endurance from a SAR capable vessel, and has significantly larger maritime activity. These three concerns can be address by the implementation of an Inshore Rescue Boat Station to reduce the risk of injury or loss of life, but as noted in the following chapter, implementing an IRB station at a specific location in the Arctic is a complicated process.

In sum, such engagement results allow us characterize the risk perception in a particular community. It also reminds us of the importance of taking the time for listening community input and empowering them to be a part of the conversation while discussing SAR asset implementations.

Further details on our engagement sessions can be shared upon request.

In the adjacent figure, red boundaries represent cabin locations. Green represents maritime routes shared by community members. Gray represent the range of VHF service.

9.1. Limitations of Inshore Rescue Boat North

Implementing an IRB station at a specific location is a complicated process, with numerous additional considerations to be expected, including cost to the Crown, logistics, community services and support, transportation schedules, and freight availability as commercial contracts are a common occurrence for a station start-up.

With those considerations, a trade-off with factors outside the scope of the RAMSARD report is required. For example, as identified in our environmental scan, when the ice-out and ice-in dates are is an important factor when considering the implementation of an IRB-N station. Given the large investment, it would be beneficial having operational assets for a whole operational season (i.e., Mid-May to Mid-September as is the case for Rankin Inlet, but this might not be the case for other busy areas such as Pond Inlet or Arctic Bay. Furthermore, IRB-N crewmembers might not be from the communities that they'll be serving, therefore limiting the knowledge on local hazards. In those cases, the establishment of a CCGA unit might the best option.

9.2. Limitations of CCGA Units

However, there's limitations as well on what can be expected from a CCGA unit, specifically in the Arctic. According to Canadian Aeronautical and Maritime Search and Rescue (CAMSAR), Canadian Coast Guard Auxiliary (CCGA) are considered an "other resource", and not a primary or secondary resource, as they do not maintain a 30 minute SAR standby posture and are not owned by the Federal Government.

9.3. Fleet Role in Arctic Engagement

Discussion about Fleet's potential roles in Arctic Engagement and CCGA SAR unit exercising and other community based events are still on-going. Very successful engagement that "placed a strong emphasis on Indigenous community engagement and marine safety in remote communities"[1] occurred during summer 2018. Since the summer of 2017, the Canadian Coast Guard has also deployed Arctic Community Engagement and Exercise Teams. These teams travelled to a number of Arctic communities and focused on providing training to local maritime SAR units.

[1] https://www.myalgoma.ca/2018/09/17/indigenous-community-engagement-and-a-safe-sealift-highlight-ccgs-samuel-risleys-maiden-arctic-voyage/

10. Resource Response Times in Incident Resolution (M1 to M3)

10.1 Air SAR Primary Response

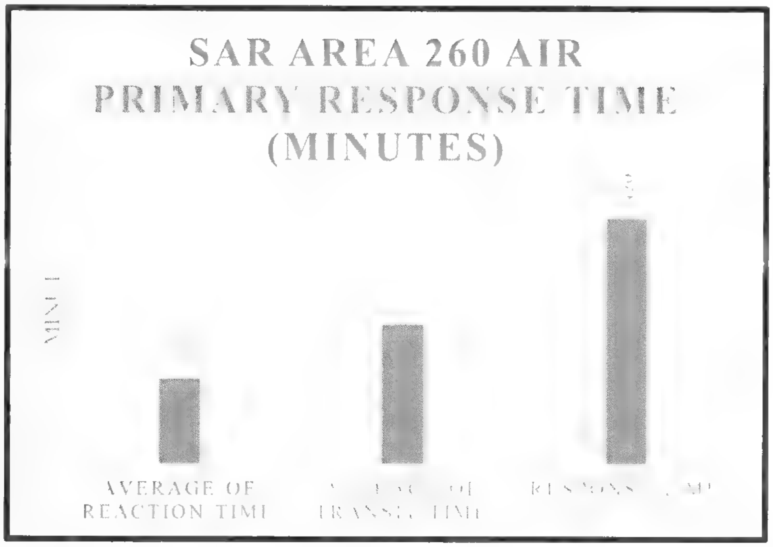
The CF – Primary SAR Air SRU's are the only resources – marine and air – that were tasked at least once in the Arctic for each year from 2012 to 2016. Two Primary Air assets in SAR Area 260 were utilized during the years of this analysis. The Hercules Airplane from JRCC Trenton and the Cormorant Helicopter from JRCC Halifax[2]. These assets were tasked to respond to incidents in Area 260 a total of 28 cases, an average of approximately seven cases per year.

Hercules are able to conduct longer flights and act as a platform for SAR Techs to launch from and stabilize a situation. The Cormorant and Griffon helicopters are used for hoisting operations, but the Griffon's fuel endurance is not practical for use in the high Arctic.

Table 5: JRCC Trenton Air SAR Primary Options

Type	# Available	Mandated Reaction Time	Fuel Endurance	Crew	Crew Schedule
CC130 Hercules (424 and 435 Squadrons)	2	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	11 hr.	7 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time
Griffon Helicopter (424 Squadron)	1	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	3 hr.	3 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time
Cormorant (103 Squadron)	1	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	5 hrs.	3 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time

[2] There are times when a helicopter is needed for an Arctic case in JRCC Trenton's Area of Responsibility (AOR). For SAR Area 260, the Cormorant from JRCC Halifax could be borrowed, if available, especially for cases close to Igloolik, Hall Beach and SAR Area 010. These request are evaluated on a case-by-case basis. Other options include chartering a private helicopter.



Reaction Time: Time from assignment of tasking to SRU departing base.
Transit Time: Time from departing base to on scene.
Response Time: Reaction + Transit time.

Figure 14: SAR Area 260 Air Primary Response Time (Minutes)

Along with Primary Air sorties, a SAR call in the Arctic usually results in JRCC multi-tasking assets (meaning a number of assets are tasked to the same SAR call). In SAR Area 260, there is no primary marine SAR, but numerous secondary marine SAR, other and vessels of opportunity. To better understand what assets are available for SAR Area 260, the next section examines their response time.

10.2 Secondary, Other, and Vessel of Opportunity Response Time

Figure 12 includes all taskings issued by JRCC for marine cases during the years of the analysis. This section presents all 'Other' SRUs that were utilized in responses from 2012-2016.

According to CAMSAR:

- ***Secondary Units*** – are all units of the Federal government that are not primary search and rescue units but which may be tasked to aid in the resolution of a search and rescue incident.
- ***Other Units*** – units, other than primary or secondary search and rescue units, which participate in search and rescue activities when required.

This includes civilian agencies, volunteers and partially Federal Government funded facilities such as the Canadian Coast Guard Auxiliary and the Civil Air Search and Rescue Association.

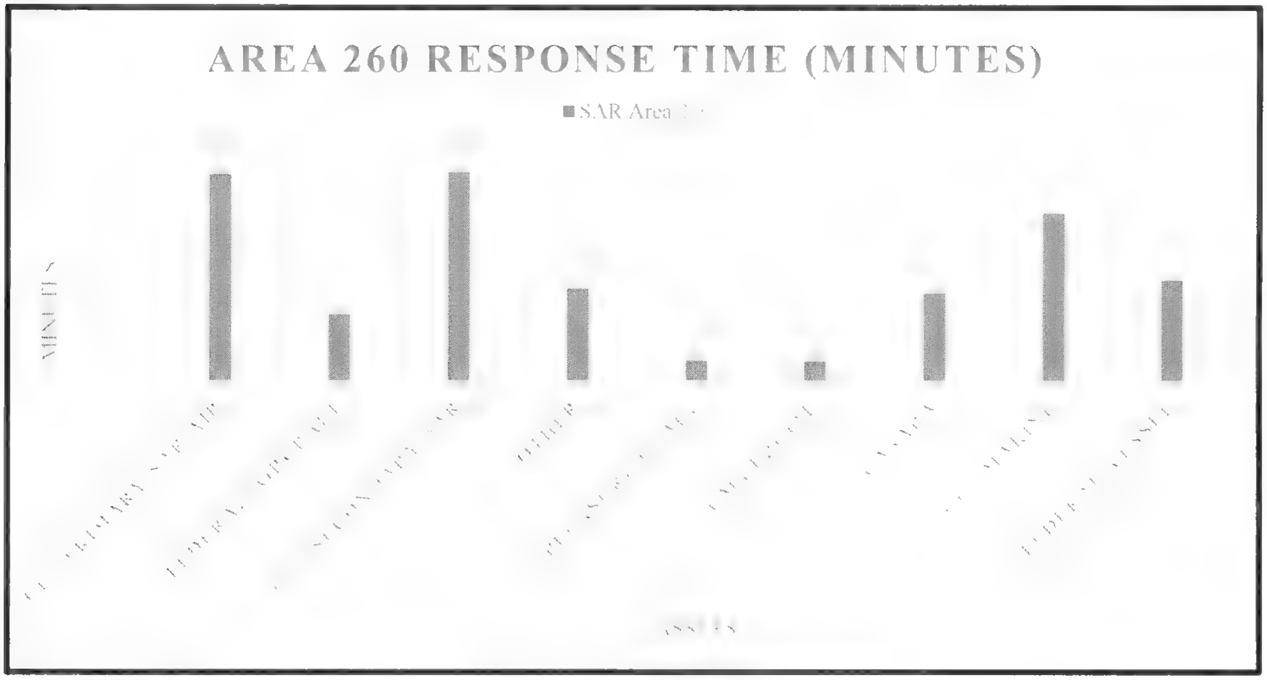


Figure 15: Response Time from Secondary and Other Units

In this figure, three cases were classified as Other. That category in this case represents a tender from a commercial vessel, and two local maritime SAR groups. One SAR group was from Pond Inlet and the other from Taloyoak. These groups organized themselves to answer local incidents. We found interesting that they appear in our data. Local maritime SAR groups not being part of the CCGA is a common occurrence in the Arctic. From our engagement sessions both in Pond Inlet and Taloyoak, the importance of communication with JRCC, training and proper insurance while being on a tasking was discussed. Communities generally express how positive the momentum of CCGA implementation is for the North. For that reason, we expect seeing greater CCGA involvement in SAR Area 260 for the years to come in figures such as Figure 12.

11. Risks Identified in the Environmental Scan

1. Small craft regularly transit 300 to 400 nm between communities along exposed shorelines
2. The Amundsen Gulf is used by all vessels transiting the Northwest Passage. It is obstructed by ice one in every ten years due to the Beaufort Gyre (clockwise rotating ice mass) pushing ice southward along Banks Island and obstructing any through traffic for the entire season.
3. In the central Arctic, lengthy small craft transits up to 400 nm between Pond Inlet and Arctic Bay leave boaters exposed to the elements for days at a time.
4. Fury & Hecla Straits near Igloolik are prone to strong currents. This passage is used by many vessels making a NWP transit.
5. Bellot Strait is shallow, narrow, and can only be transited at high tide for large vessels. This passage is used by virtually all vessels making a NWP transit.

12. Summary of Incident Data Review and Analysis

- There were to 132 SAR cases (M1 to M3) in the Arctic from 2012 to 2016.
- 91% of all M1 to M3 cases in SAR Area 260 are for disabled, overdue, stranded or grounded pleasure crafts.
- Pond Inlet (n=7), Arctic Bay (n=6) and Gjoa Haven (n=3) are respectively the busiest communities of SAR Area 260 from 2012 to 2016.
- JRCC Trenton is contacted first in 33% of M1 to M3 cases involving pleasure craft in SAR Area 260
- EMO Nunavut is contacted first in SAR Area 010 (46%) and 260 (41%) for M1 to M3 cases involving pleasure craft. JRCC Trenton is contacted first in SAR Area 155 (24%). In SAR Area 259, RCMP is alerted first 62% of the time with MCTS Iqaluit receiving the remainder of the notifications (38%).
- JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.
- The month with the highest average number of marine case for SAR Area 260 is September.
- JRCC Halifax averages 4.36 cases/community per span of five years while JRCC Trenton averages 1.79 cases/community.
- For every M1 SAR case, JRCC is activated five times out of six in the Arctic.
- SISAR numbers are not accurate, especially with respect to M2 and M3 cases. We estimate 4-5 M2 or M3 cases per community per year.
- Out of the six SAR cases (M1 and M2) involving commercial activity, five were due to symptoms of a heart attack or loss of consciousness.
- In SAR Area 260, 97% of the maritime response in the Arctic is by a vessel of opportunity, 65% being the Coast Guard.
- There's been no CCGA involvement in Area 260 from 2012 to 2016. Meeting the Coast Guard Performance Standard

According to the Coast Guard Levels of Service and Service Standards 2007, the Coast Guard has set a Performance Standard level of 90% of lives at risk being saved in conventional cases. The performance standard is expressed as a percentage and is calculated using the formula

$$\textit{Lives Saved} = (\#\ \textit{people saved from imminent danger})$$
$$\textit{Lives at Risk} = (\textit{lives saved} + \textit{lives lost} + \textit{lives missing})$$

The table below shows the total number of people involved in M1 and M2 cases only. M1/M2 cases may have a combination of people assisted, saved, lost and missing.

M3 cases are not considered when calculating the performance standard as no risk to life exists. Similarly, POB 'assisted' are not included as 'saved' because their lives were never at risk. A distress call can arise when just one person on board a vessel is facing a life-threatening situation.

Table 6: 2012 – 2016 Coast Guard Performance Standard for SAR Area 260

Year	Number of POB (people onboard)	Number of POB Assisted	Number of POB Saved	Number of POB Lost	Number of POB Missing	Result %
2012	23	0	21	1	1	91.30
2013	24	0	24	0	0	100.00
2014	24	0	23	1	0	95.83
2015	29	11	18	0	0	100.00
2016	47	0	46	0	1	97.87
Grand Total	**147**	**11**	**132**	**2**	**2**	**97.06**

For the years of this analysis in Area 260, the Coast Guard has achieved an average Performance Standard of 97.06 %, with the lowest annual Performance Standard being 91.30 %. **This is above the acceptable standard of 90%.**

As defined in the Canadian Coast Guard Level of Service - Service Standards, June 2004 - 90% effectiveness is expected to be achieved during "conventional incidents" in which:

a. *resources are able to respond within a short period of time;*
b. *the search object is located by the responding resource on scene in a timely manner;*
c. *environmental, geographic, and hydrographic conditions have little impact on the successful resolution of the incident; and*
d. *The responding resource has the necessary capability and capacity to effectively resolve the incident.*

Fisheries and Oceans Canada | Pêches et Océans Canada
Canadian Coast Guard | Garde côtière canadienne

2018-19 Maritime Search and Rescue Arctic Analysis (Area 155)

#	Date	Description	Initials

Approvals

Jean-Sébastien Landry and James Hare Regional RAMSARD Analyst	Approved : JSL JH Date: 18/03/2019
Steve Thompson Deputy Superintendent, Arctic Operations	Approved : Date: 18-Mar-2018
Peter Garapick Superintendent, Arctic Operations	Approved : (S. Thompson for) Date: 18-Mar-2018
Neil O'Rourke Assistant Commissioner, Arctic Region	Approved : Date:
Sheyla Dussault SAR Manager, Operations	Approved : Date:
Julie Gascon Director General, Operations	Approved : Date:
Mario Pelletier Deputy Commissioner, Operations	Approved : Date:

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1. Recommendations Table for SAR Area 155

#	RISK	RECOMMENDATIONS
SAR AREA 155		
1.	**LACK OF SECONDARY SAR IN ACTIVE MARINE COMMUNITIES** **Hall Beach (n=7), Igloolik (n=4), Coral Harbour (n=2), Naujaat (n=2), James Bay Communities (n=2), Sanikiluaq (n=1), Puvirnituq (n=1), Kuujjuarapik (n=1)** and **Akulivik (n=1)** are respectively the most active Arctic communities of SAR Area 155 without Primary or Secondary SAR Capacity. - Hall Beach and Igloolik have regular small craft transiting In SAR Area 155, from 2012 to 2016, local CCGA had a role in 4% of incident resolution.	• Focus the implementation of CCGA in these communities.
2.	**HIGH POTENTIAL OF SMALL CRAFT TRAFFIC BETWEEN COMMUNITIES DURING THE SUMMER** • Small craft regularly transit 300 – 400 nm between communities along exposed shorelines	• Continue the implementation of CCGA units in Arctic communities through the OPP's CCGA Expansion and Community Boat initiatives • Increase the presence of Coast Guard SAR training officers in the Arctic • Increase the safety culture by leveraging CCGA presence via regional Boating Safety MOU with Transport Canada

3.	**LIMITED BOATING SAFETY / SAR INCIDENT MANAGEMENT STRATEGY IN THE ARCTIC** • Poor survival time of mariners in distress due to cold water • Elders and CCGA personnel reported young people are being irresponsible while boating – taking on higher risk, departing in poorer weather • Limited charts available in local communities for SAR planning	• Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly territorial governments • Sign regional MOU with Transport Canada to increase boating safety culture by leveraging CCGA • Recruit young people into CCGA, provide communities/hamlet offices an outlet to receive updates from JRCC during incidents • Fund Canadian Safe Boating Council campaigns such as Operation Life Preserver. Provide boater education on the effects of cold water, HELP position, and distribute life jackets and floater suits • Recommend expansion of the mandate of Canadian Safe Boating Council's Operation Life Preserver to include floater suits for northern mariners. • Distribute buoyancy tanks for installation in small craft so they do not sink when swamped/ capsized. • Chart to modern standards all small-craft navigable waters within 75 nautical miles of populated areas • MOU agreement between the Coast Guard and the Canadian Hydrographic Survey Resource for Arctic SAR Team to use charts as engagement gifts. They are more cost-effective than most options and far more sought-after by communities

4.	**HIGH RISK GROUNDING FROM PASSENGER VESSELS** • For passenger vessels, the most common issues are running aground due to poor navigation or charting. Examples include Clipper Adventurer (197 POB) in 2010, and Akademik Ioffe (162 POB) in 2018. • Russian Charts of the Canadian Arctic are considered more useful than Canadian Hydrographic Service resources • Recent ice conditions opens unexplored areas	• Chart all navigable waters within 200 nautical miles of populated areas • Improve or increase Canadian Hydrographic Survey Resources • Implementation of the Low Impact Shipping Corridors initiative • Increase Coast Guard presence in the Arctic
5.	**LACK OF SAR RESOURCES IN HUDSON BAY, JAMES BAY, HUDSON STRAIT, AND FOXE CHANNEL** • Mid-season usually associated with all ice breakers being in the high-arctic • Major SAR gap in those areas for up to six weeks per season	• Implementation of an offshore patrol vessel in Hudson Bay o Review Arctic vessel activities with the ROC and identify SAR gap o Review JRCC Trenton and Halifax charted options, complete a cost analysis and evaluate with current OPP initiatives implementation
6.	**ADDITIONAL FUEL INFRASTRUCTURE FOR IRB-N IN RANKIN INLET** • In the Arctic, crew endurance is usually related to fuel capacity	• Ensure additional fuel availability in Rankin Inlet and in surrounding communities

7.	**COAST GUARD IS NOT ALWAYS NOTIFIED OF SAR MARINE CASES** • Many SAR incidents go unreported in the North • MCTS Iqaluit is not yet adjusted on instant communication for SAR incidents • Confirmation bias exists in SAR reporting: locals will only call government for help if they know the government is nearby • JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.	• Link Iqaluit MCTS services to community towers to offer services. It is recommended that steps be taken to allow MCTS Iqaluit to monitor community VHF towers for offering services such as sail plans, weather, issuing MARB's, and coordinating searches with JRCC. • Provide communities (via Hunters and Trappers Associations / Organizations) with loanable AIS/InReach/SPOT devices to minimize search time • Increase public awareness of JRCC and the SAR system (i.e., who to call, how it works) • During SAR incidents, provide communities / hamlet offices an outlet to receive updates from JRCC • Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly the territorial government
8.	**JRCC and MCTS – Lack of environmental data**	• Provide the Rescue Coordination Centre with data to account on ice drifts and characteristics when planning for searches.
9.	**JRCC and MCTS – Lack of position finding capability** • VHF in Arctic not equipped with RDF • No Cellular GPS Positioning Capabilities	• Increase MCTS RDF capabilities • Provide small craft with loanable AIS/InReach/SPOT devices to minimize search time • Provide JRCC general locations of cabins on shore, used by locals in the event of adverse weather conditions

10.	**JRCC and MCTS – Lack of Inuktitut Speaker / Operator** • Large number of Inuktitut only speaking mariners, difficulty for locals to communicate with JRCC and MCTS	• Ensure 1 MCTS officer can translate Inuktitut to English • Ensure timely access to Inuktitut interpretation services in interim

2. Arctic SAR Area 155 Summary

In summary, the Canadian Coast Guard achieved its Performance Standard in SAR Area 155 with a rating of 96.67%; above the acceptable standard of 90%. However, the Coast Guard failed to meet the performance standard during 2014.

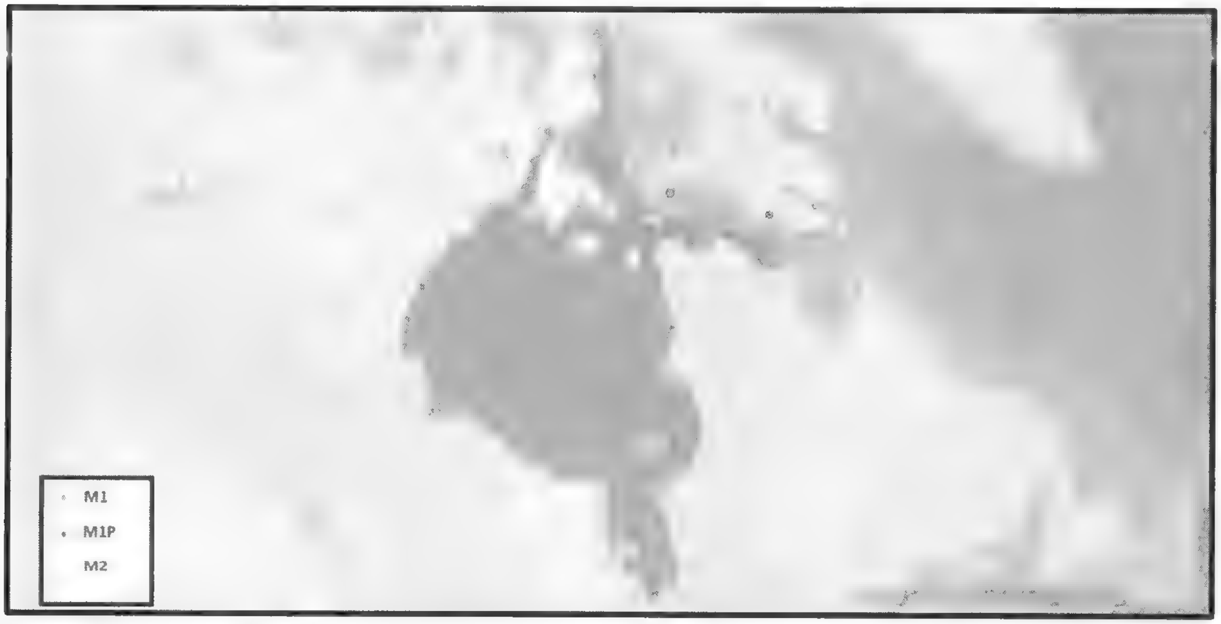


Figure 1 : Regions of risks identified in SAR Area 155

SAR response time remains an issue in SAR Area 155. 95% of the region cannot be reached by a primary or secondary SAR unit within 4 hours. The Canadian Coast Guard is at risk to fall below the performance standard again should the volume or nature of incidents change. For this reason, the analysis team has found that:

<u>A situation exits that requires immediate action</u>

To mitigate the risk of injuries and lives lost due to marine SAR incidents, the recommendations in this report the team has chosen to highlight for further considerations are:

1. The continuation of CCGA implementation in Arctic communities
2. The establishment of a SAR prevention strategy adapted for northern climates
3. Increase support and resources for the IRB in Rankin Inlet
4. The implementation of an offshore capable SAR vessel in Hudson Bay

If implemented, the analysis team has concluded that the level of risk to the Coast Guard with regards to SAR delivery will be lowered and the Coast Guard Performance Standard results will improve.

3. Introduction

Due to the limited scope, but large area under study – 50 % of the coastline of the country – this study did not have the intention to focus on regionally-specific challenges, like specific shipping channel navigational risks, specific implications of SAR in ice-breaking operations, or Arctic Mass-Rescue Scenarios, which are already taken care by Subject Matter Experts (SME). For this reason, the readers of this report should also consult experts at the Maritime Communications and Traffic Services Centre in Iqaluit, the Regional Operation Centre in Montreal, the Joint Rescue Coordination Centres in Trenton and Halifax, and Subject Matter Experts on Mass Rescue prior of making decisions affecting their Arctic operations.

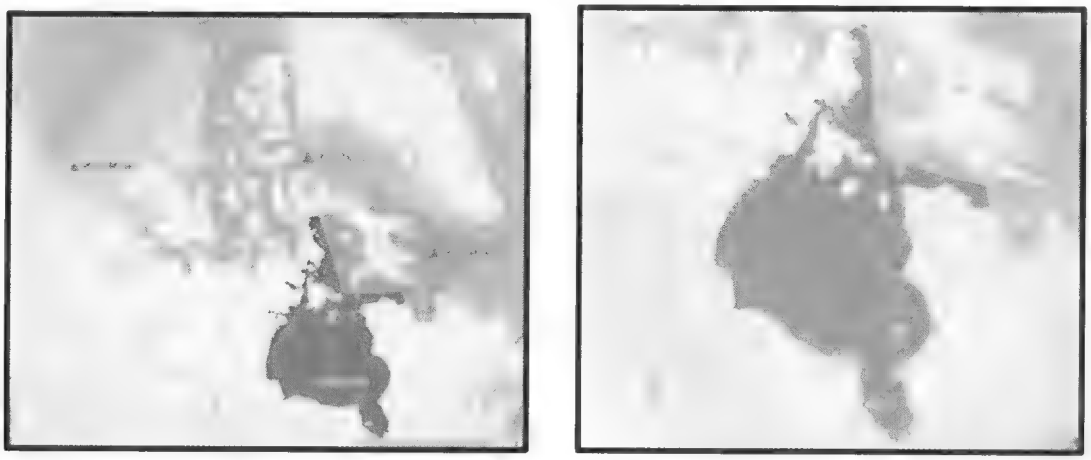


Figure 2 and 3 : Map of SAR Areas under review and Map of SAR Area 155

Area 155 is served by Joint Rescue Coordination Centre (JRCC) Trenton for coordination of maritime search and rescue (SAR).

This document is a risk-based analysis of maritime SAR delivery in SAR Area 260 using data from 2012-2016. The purpose of this report is to identify the need for Coast Guard SAR assets using historical incident data and SAR partner engagement. Current SAR delivery will be assessed using the Canadian Coast Guard SAR Performance Standard.

SAR Area 155 encompasses Hudson Bay, Foxe Basin, and Davis Strait. The regional population is approximately 30,000. SAR Area 155 is a mix of Inuit and Cree communities. The most commonly spoken languages are Inuit and English.

All details concerning wind, ice, tides, commercial and local maritime activities, and more, can be found in our environmental scan at **Annex B.**

Throughout the report, the analysis team started with an overview of the SAR Area, followed by a review of SAR incident data from the Coast Guard's System of Information on Search and Rescue (SISAR). This is followed by a summary of SAR engagement, and a section on primary SAR vessels and SAR incident response characteristics in relation to the Coast Guard Performance Standard for SAR.

4. Incident Data Review and Analysis – SISAR

As per the Canadian Aeronautical and Maritime Search and Rescue (CAMSAR) manual, the definitions of the classifications of marine cases are as follows:

- ***M1* - Distress** – *A person or persons from a vessel are threatened by grave and imminent danger and require immediate assistance.*
- ***M1P* - Distress Reported After the Fact** – *An M1 case that has been resolved but would have required a response had the SAR system been alerted at the time of the case.*
- ***M2* - Potential Distress** – *The potential exists for an M1 case if timely action is not taken; i.e., immediate response is required to stabilize a situation in order to prevent distress.*
- ***M3*** - *A maritime situation other than an M1 or M2 case, where assistance is rendered to prevent case degradation to greater potential danger.*

4.1 Incident Analysis – M1 to M3

SAR Area 155 is home to a unique combination of population clusters with significant small craft activity, storm surges, commercial tug operations, and cargo movements. In SAR Area 155, small craft becoming stranded was the most common issue. Such distress would typically worsen due to inability to signal for help and/or due to harsh environmental conditions.

SAR cases near Rankin Inlet (n=9) and Hall Beach (n=7) were the most common for the analysis period. The other locations where SAR cases occurred were Igloolik (n=4), an additional one involving a transit between Hall Beach and Igloolik, Whale Cove (n=4), Chesterfield (n=2), Coral Harbour (n=2), Naujaat (n=2), Arviat (n=2), James Bay communities (n=1), Sanikiluaq (n=1), Puvirnituq (n=1), Kuujjuarapik (n=1) and Akulivik (n=1).

Considering that as of 2018, communities of Rankin Inlet, Whale Cove, and Chesterfield Inlet can be serviced by the Inshore Rescue Boat – North (IRB-N) station in Rankin Inlet (weather dependent), the remaining SAR gap concerns the communities of Hall Beach, Igloolik, Coral Harbour, Naujaat, the James Bay communities, Sanikiluaq, Puvirnituq, Kuujjuarapik and Akulivik.

According to JRCC Trenton, there is sizeable traffic in the corridor between Hall Beach and Igloolik. The two communities seem to be linked, with a lot of families travelling back and forth in a high-risk area due to the open seas. During our engagement sessions, we confirmed travel between communities is a common occurrence in the Arctic, especially when communities are in proximity to one another.

Figure 4: Incidents by Activity – Area 155

Another high-risk area according to JRCC Trenton the surrounding communities of Rankin Inlet, with marine SAR cases occurring at least once per year. Traffic departing Rankin Inlet can travel as far as Coral Harbour or Naujaat. We can also expect a lot of traffic in James Bay, between the Western Nunavik communities, and travels from/to Sanikiluaq.

4.2 Alerting Method

In SAR Area 155, JRCC Trenton is most often alerted first (28%), followed by Nunavut EMO (26%). As shown below, in addition to JRCC, many community organizations, other departments and agencies seem to be alerted, and then a possible subsequent notification of JRCC. This demonstrates the need to continue with education sessions on the SAR system – who to call, and when to call – to ensure timely activation of the Federal SAR system.

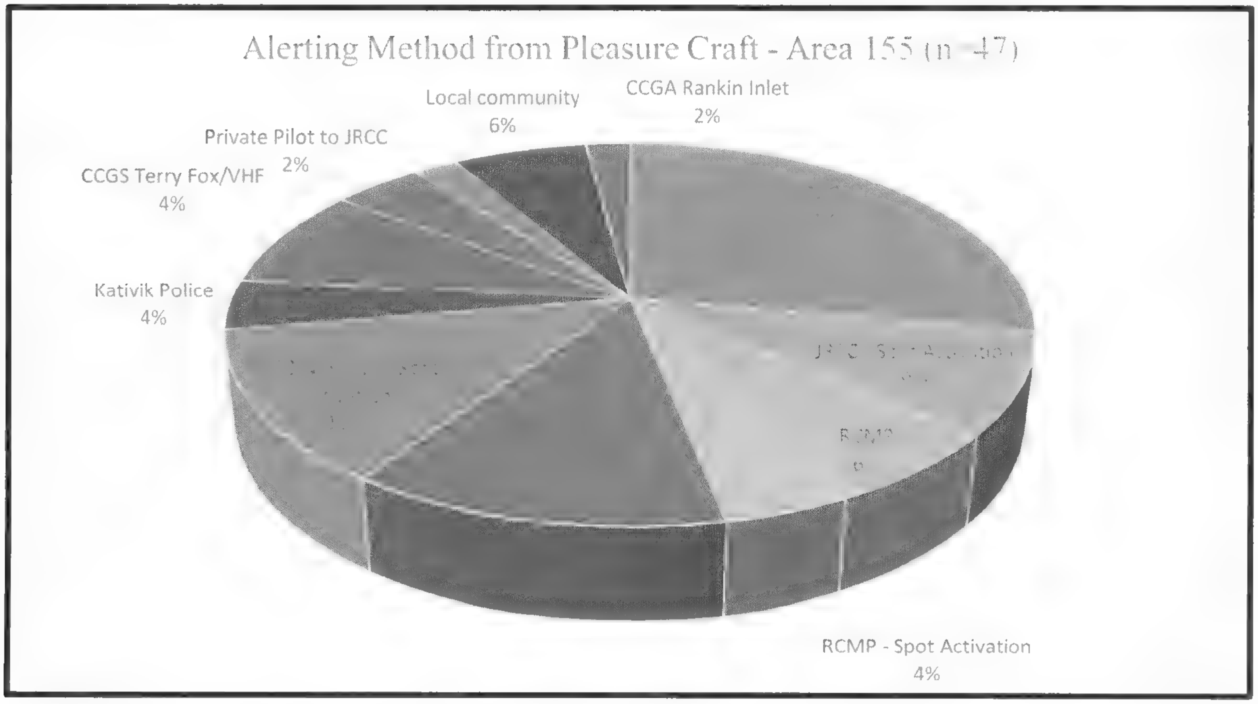


Figure 5 : SAR Area 155 Method of Alerting for Pleasure Craft

Only one call came from a commercial vessel in Area 155 from 2012 to 2016 and MCTS Iqaluit was directly alerted. For the period examined, no incidents involving fishing vessels were reported in SAR Area 155.

4.1 Monthly Distribution M1 Cases

Figure 6 shows an overall picture of M1 cases that have occurred in SAR Areas 259, 260, 155 and 010. The results are generalized for the entire Arctic due to small data sets from individual SAR areas.

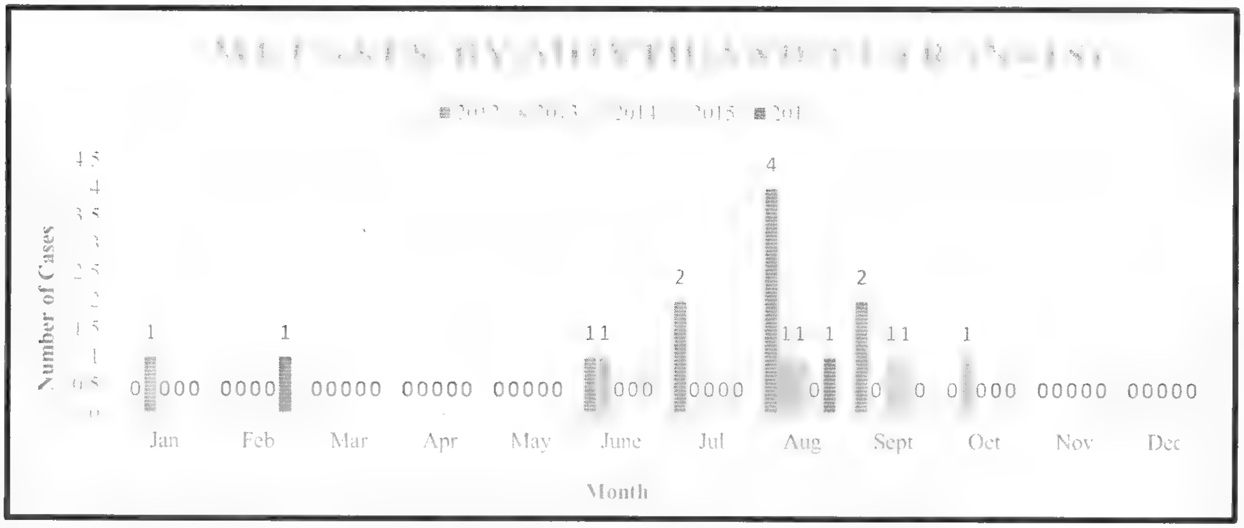


Figure 6: M1 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.2 Monthly Distribution M2 Cases

Figure 7 shows an overall picture of M2 cases that have occurred in SAR Areas 259, 260, 155 and 010. July (n=10), August (n=11) and September (n=9) saw the greatest number of M2 cases. Throughout the period examined, there were no M2 cases reported from December to May.

Figure 7: M2 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.3 Monthly Distribution M3 Cases

Figure 8 shows an overall picture of M3 cases that have occurred in SAR Areas 259, 260, 155 and 010.

The greatest number of M3 incidents occurred in August. M3 cases peak during the summer months with incidents extending earlier and later into the shoulder seasons, respectively.

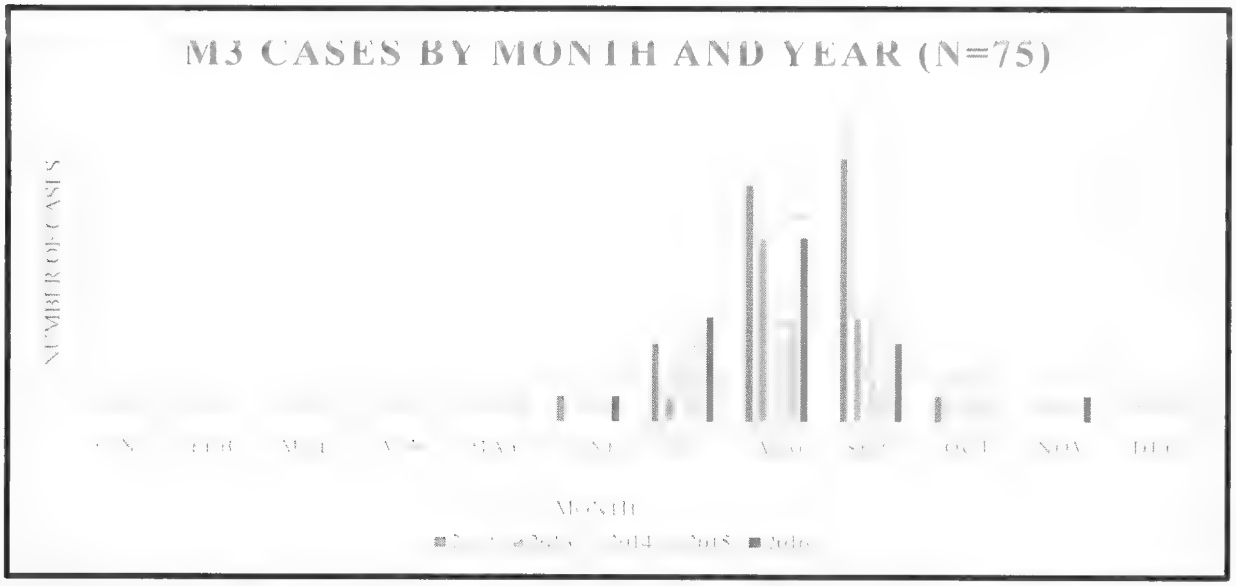


Figure 8: M3 SAR Cases by Month and Year for SAR Areas 259/260/155/010

5. Distribution of M1, M2, and M3 SAR Cases

From 2012-2016; 75 M3 cases were reported to JRCC, 39 M2, and 18 M1 **in all four** arctic SAR Areas.

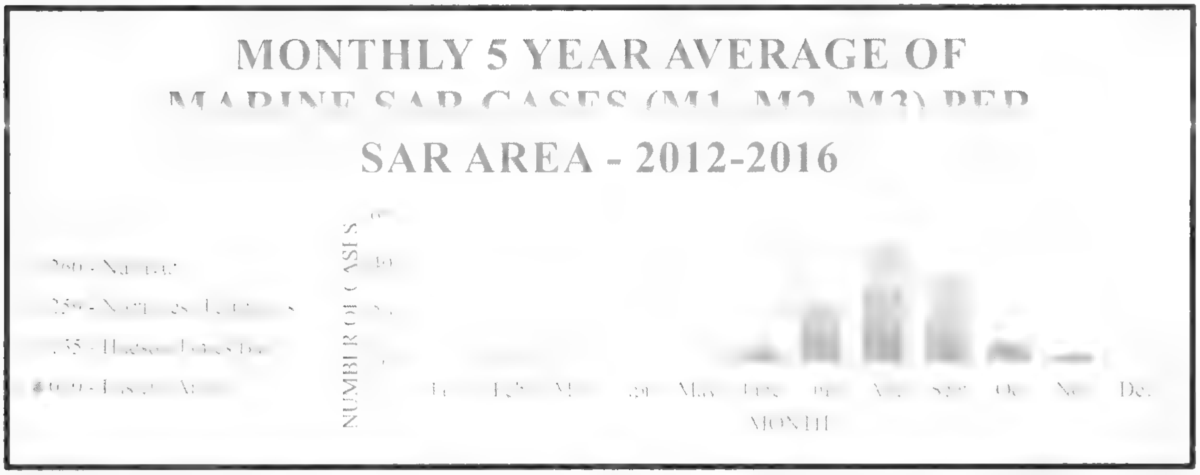


Figure 9: Monthly Five-Year Average of Marine SAR Cases (M1, M2, M3) by SAR Area for SAR Areas 259/260/155/010

The month with the highest average number of marine case for SAR Area 155 is August, due to the high volume of seasonal pleasure craft and commercial traffic. Small craft can be found on the water at any time of year. If open water exists, Inuit are likely engaged in harvesting activities. A January 2013 example of an M1 case, was a local vessel overdue from a seal hunting expedition. Late summer is when M1 to M3 cases peak in volume.

SAR Area 155 had <u>43</u> SAR cases during the 5-year period of study.

Table 1: Number of cases per community in SAR Area 260 (5-year period)

SAR Area	Number of communities	Number of cases	Total average (cases/community)
155	28	48	1.54

Through SAR partner engagement; it was identified that SAR statistics are underreported and the SAR case values presented in SISAR databases **do not capture all marine incidents**. From community engagement sessions; it was estimated that **the *actual* number of SAR cases that occur annually is <u>4-5 incidents per community</u>**. In SAR area 155, this represents between 13.02 to 16.27 times as many incidents occurring as are reported. Without providing a number, JRCC relayed the same picture of SAR underreporting. Wherever assets are not available, the federal SAR system is not activated, thus presenting as if such an area has no need for SAR resources.

It was pointed out during our engagement sessions that each time the local SAR vessel is utilized in a community, it might not be to respond as what Coast Guard would classify as a M1, M2, or M3 case. As an example, sometimes a community will ask their local marine SAR unit to bring kids on a traditional

camp instead of using smaller vessels from the community to ensure safe passage. Tasking authorization for these type of SAR-prevention cases might be confusing. For locals it could equally be hard to understand why such request might be refused by a primary SAR asset.

6. Risk Matrix – Based on Five Years of Historical Data – 2012 to 2016

The risk portrayed in Figure 10 has been calculated using historical SISAR data from 2012 to 2016.

The criteria for determining how each category would be placed in the risk matrix (likelihood and impact) can be found in Tables 2 and 3.

Table 2 and 3 – Risk Matrix Likelihood Criteria and Risk Matrix Impact Criteria

Likelihood Legend		Range for likelihood number
Almost Certain	1 incident or more per week	52+
Likely	1 or more incident per month	11 to 51
Moderate	1 or more incident per year	1 to 11
Unlikely	1 incident every 10 years	0.1 to 0.9
Rare	1 incident every 25 years or more	0.04 to 0.09

Impact Legend	
Extreme	More than 50 at risk in incident.
High	More than 10 lives at risk in incident.
Moderate	More than 5 lives at risk in incident.
Low	One to five lives at risk in incident.
Negligible	No lives at risk in incident.

Impact					
Extreme					
High					
Moderate					
Low		M1 Commercial M2 Commercial	M1 Pleasure M2 Pleasure		
Negligible			M3 Commercial	M3 Pleasure	
	Rare	Unlikely	Moderate	Likely	Almost Certain
	Likelihood				

Figure 10: Risk Matrix – Area 155

Overall, commercial vessels were found to have a low risk in SAR area 155. Medium-sized crews of 15-25, knowledgeable staff, safety culture, and size were all factors which made vessels carrying general cargo, ore, fuel, and vehicles to-and-from the Arctic a low risk. Fishing vessels have been omitted from this study as SAR area 155 does not have a commercial fishing fleet.

Pleasure craft (including those used for harvesting) can be found in large quantities in every community. Due to the volume of small craft traffic that Area 260 sees every season, the likelihood of an incident occurring is relatively high. The impact of pleasure craft incidents are low, due to the number of people on board such a vessel. Low impact is defined as 1-5 lives at risk during an incident as per Table 3. Factors affecting the likelihood of a small craft incident are the level of boater education and the number of boaters within a community. Population growth in the Arctic coupled with a general minimal level of SAR system knowledge corresponds to an increased need for SAR assets. This is due to an increased likelihood of an incident occurring, as per the matrix in Figure 10. Well-informed boaters make smarter choices and are more likely to avoid hazardous situations altogether. With that in mind, due to the small number of incidents which occur in SAR area 155 – it only takes one life lost/ missing from a marine SAR case for the Canadian Coast Guard to fall below its performance standard of 90% lives saved.

7. Asset Response in Incident Resolution – (M1 to M3)

In the Arctic, multiple assets are tasked at the same time. During the same SAR case, assets can also have multiple sorties due to refueling. The table below represents the number of times an asset was tasked for all SAR cases examined.

Multiple sorties or responding assets for the same SAR case are shown by the table below.

Table 4: Resources Tasked - SAR Area 155

Unit Tasked	*Number of Time Tasked*	*Source*
N/A	0	Primary Maritime SAR
Total	***0***	
CCG Ship Opportunity	13	Secondary Maritime SAR
Federal Vessel	2	
Total	***15***	
CCGA	6	Other - Maritime
VOO Fishing	0	
VOO Commercial	6	
VOO Pleasure	27	
Provincial Vessel	2	
Total	***41***	
CORM	19	Primary Air SAR
GRIF	2	
HERC	56	
Total	***77***	
Various CF Air	12	Secondary Air SAR
CCG Air Opportunity	2	
Federal Aircraft	3	
Total	***17***	
CASARA	3	Other - Air
AOO Commercial	6	
Private Aircraft	0	
Total	***9***	
Grand Total	***159***	

The table above identifies SAR resources that responded when tasked for an M1, M2, or M3 incident by JRCC Trenton in SAR Area 155. It is common for multiple units to be tasked to the same incident.

SAR response relies heavily on all three types of air resources and 'other' marine resources. For the time period examined, there were no primary SAR assets in SAR Area 155.

SAR incidents mostly happen near-shore and in close proximity to inhabited places (Figure 11). However, location data is not available for all taskings in the period examined.

Figure 11: SAR Area 155 Incidents Locations

The following is a graphic depiction of the incident locations for SAR Area 260.

8. Canadian Coast Guard Auxiliary in the Arctic

From 2012-2016, the Canadian Coast Guard Auxiliary was intermittently operating a CCGA unit in Rankin Inlet.

Figure 12: Rankin Inlet CCGA coverage map

8.1 Number of Cases Answered by CCGA

During the years of 2012-2016 CCGA Rankin Inlet responded to eight SAR cases.

Table 5: Breakdown of Cases Answered by CCGA – SAR Area 155

2012	155 (M2)	A call from Jack Kruger about 3 males stranded on Ground Squirrel island 8nm South of Rankin Inlet requesting assistance from Coast Guard. 2 having unknown medical conditions. CGA/RCMP vessel went out to rescue the males and brought them back safely to shore. Case closed.
2012	155 (M2)	Spot activation near Whale Cove for an 18' motorboat with 3 POB. CCGA from Rankin Inlet tasked to assist. Disabled vessel was towed to Whale Cove. CASE CLOSED.
2012	155 (M3)	Spot activation from a disabled vessel with 1 Person on Board (POB). Broadcast issued. CGA Rankin tasked to towed vessel to port.
2012	155 (M3)	Reports of disabled vessel between Marble Isl. and Rabbit Isl. near Rankin Inlet. CGA tasked to assist unit. Two CGA vessels went out and towed the disabled vessel back to Rankin.
2012	155 (M3)	Jack Kruger passed report of overdue boaters from Whale Cove to Rankin Inlet. A 62 year old male, 3 teens, and 1 child. 2 boats from Whale Cove went searching the area and 1 CGA from Rankin Inlet. Vessel was located close to Rankin Inlet by the CGA all in good health. Case Closed.
2015	155 (M3)	Overdue freighter canoe with 7 pobs reported from Rankin Inlet. CGA Touchy Subject and CG 302 tasked. CGA boat located missing boat and escorted them back to town. Case Closed
2016	155 (M3)	CGA member in Rankin Inlet reported overdue boaters reportedly stranded on an island between Whale Cove and Rankin Inlet, NU. Local CGA member gathered information and advised that local search and rescue organization proceeded to retrieve stranded persons. All back safe. Case Closed
2016	155 (M4)	Towboat US reported a SPOT beacon on a 20ft vessel with 2 x POB in Rankin Inlet. RCMP, EMO Nunavut advised. CCGA Touchy Subject tasked to search. VBR issued EGC and VFF issued pan broadcast. SPOT beacon updates indicated vessel and POB are all ok. All assets stood down. Case Closed.

In total, Rankin Inlet CCGA was tasked to respond for two M2 in 2012. Five cases were classified as M3, with three occurring in 2012 and two from 2015 to 2016. With one classified as a false alarm (M4).

Looking solely at these statistics, it could be hard to understand how much CCGA contributes to maritime Search and Rescue in the Arctic due to the limited amount of taskings. However, from engagement with the Joint Rescue Coordination Centres in Halifax and Trenton, it was clear how a CCGA unit can have a significant impact on a community's SAR capacity. As an example, Rankin Inlet CCGA responded to five cases in 2012, but was not active in 2013 and 2014. During 2013 and 2014, no cases involving pleasure crafts were reported to JRCC near Rankin Inlet. Accordingly, such results seems to illustrate how successful CCGA units do get tasking and how they encourage locals to be a part of the national SAR system.

Furthermore, a CCGA unit creates a safety culture in the community that cannot be underestimated. Programs such as the Inuit Marine Monitoring Program, the Operation Life Preserver Project, or the Guardian Program all interrelate with the broad CCGA and Coast Guard mission of SAR or maritime domain awareness.

If additional CCGA units are created and training programs are provided, ensuring capable and efficient units, the number of taskings to Arctic CCGA unit are expected to increase in the upcoming years. It is important to note only two communities in the Arctic had a local CCGA unit deployed on a tasking issued from JRCC from 2012 to 2016.

Limitations of CCGA response exist due to the nature of their work. CCGA vessels are not required to maintain a 30 minute standby posture as they are not owned by the federal government. For this reason alone, such units are categorized as 'other' and do not count as primary or secondary SAR assets. It is also possible that units may not be able to respond to all taskings due to personal commitments, crew availability etc.

8.2 Rankin Inlet IRB SAR Coverage

Funded by the Oceans Protection Plan, a new IRB station was opened in Rankin Inlet in June 2018, which was operated by Coast Guard trained Indigenous post-secondary students under the supervision of an experienced CCG Petty Officer. CCG also employed two Operational and Community Liaisons, who were Rankin Inlet residents and experienced mariners and acted as liaisons between the Rankin Inlet IRB and the community. They also provided regional on-water expertise, due to the limited charting in the region.

The operational dates for the Inshore Rescue Boat North station in Rankin Inlet were from June 27, 2018 to September 4, 2018, and it will re-open in mid-June 2019. Thus far, the unit has provided effective SAR coverage from Chesterfield Inlet (North) to Whale Cove (South).

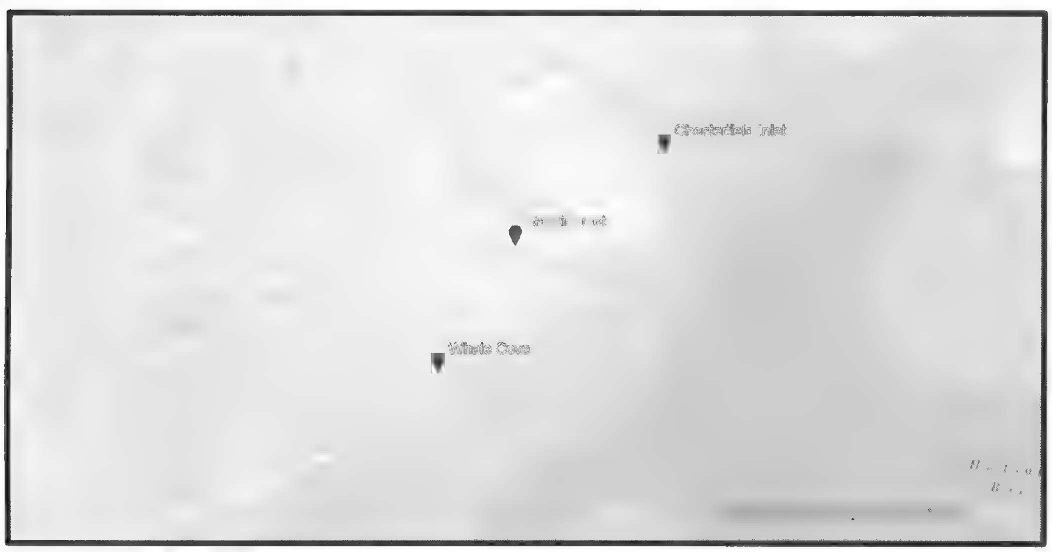


Figure 13: Rankin Inlet IRB SAR Coverage

This Inshore Rescue Boat station responded to three search and rescue cases during its first year. The crew spent over 103 hours on-the-water, and travelled 1929 nautical miles, or 3572 kilometers.

Taskings may be made beyond the area of responsibility (AOR) at the discretion of the Joint Rescue Coordination Centre, in consultation with the Coxswain.

Figure 14 : Inshore Rescue Boat - North

9. Resource Response Times in Incident Resolution (M1 to M3)

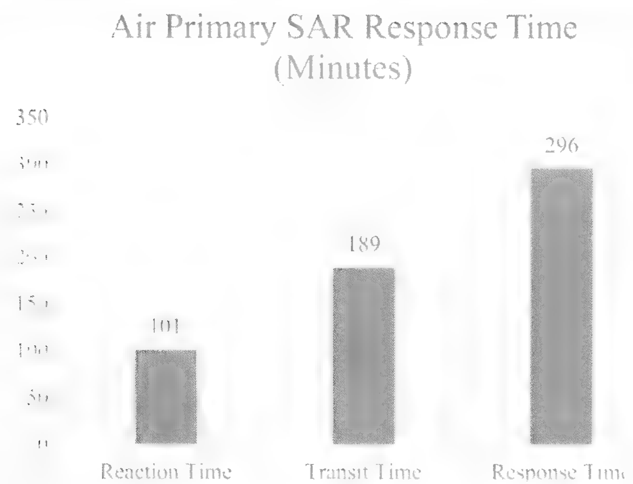
9.1 Air SAR Primary Response

The CF – Primary SAR Air SRU's are the only resources – marine and air – that were tasked at least once in the Arctic for each year from 2012 to 2016. Three Primary Air assets in SAR Area 155 were utilized during the years of this analysis. Both the Griffon and Cormorant helicopters were utilized to reach the surrounding areas of Arviat and Coral Harbour.

Hercules are able to conduct longer flights and act as a platform for SAR techs to launch from and stabilize a situation. The Cormorant and Griffon helicopters are used for hoisting operations, but the Griffon's fuel endurance is less practical for use north of James Bay. Requests to JRCC Halifax for a Cormorant are evaluated on a case-by-case basis. Other options include chartering a private helicopter.

Table 6: Area 155, 259 and 260 – JRCC Trenton

Type	# Available	Mandated Reaction Time	Fuel Endurance	Crew	Crew Schedule
CC130 Hercules (424 and 435 Squadrons)	2	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	11 hr.	7 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time
Griffon Helicopter (424 Squadron)	1	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	3 hr.	3 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time
Cormorant (103 Squadron)	1	30 min. between 8-4 on weekdays, 2 hrs. after hours and on weekends	5 hrs.	3 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time



Reaction Time: Time from assignment of tasking to SRU departing base.
Transit Time: Time from departing base to on-scene.
Response Time: Reaction + Transit time.

Figure 15 : SAR Area 155 Air Primary Response Time (Minutes)

9.2 Secondary, Other, and Vessel of Opportunity Response

Figure 16 includes all taskings issued by JRCC for marine cases during the years of the analysis. This section presents all 'Other' SRUs that were utilized in responses from 2012-2016.

According to CAMSAR:

- ***Secondary Units*** - are all units of the Federal government that are not primary search and rescue units but which may be tasked to aid in the resolution of a search and rescue incident.
- ***Other Units*** – units, other than primary or secondary search and rescue units, which participate in search and rescue activities when required.

This includes civilian agencies, volunteers and partially Federal Government funded facilities such as the Canadian Coast Guard Auxiliary and the Civil Air Search and Rescue Association.

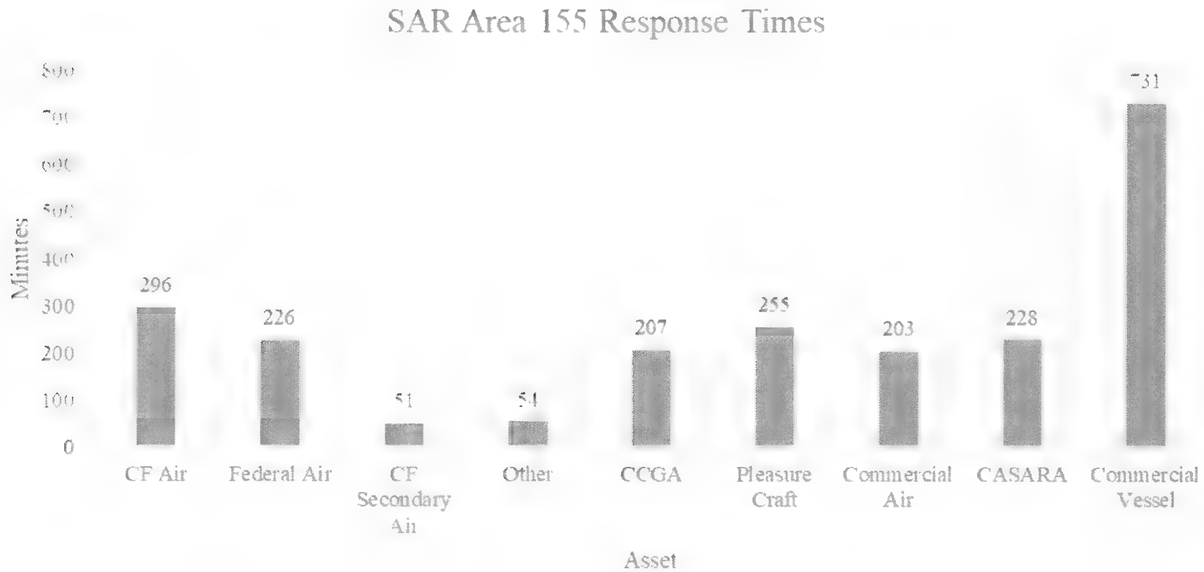


Figure 16: Response Time from Secondary and Other Units

In this figure, the "other" category represents two SAR assets from James Bay Area utilized on two separate case. The first being a police vessel from Kashechewan and the second being an aircraft from Moosonee. Both towns are in the province of Ontario. Very little information is available concerning the James Bay communities, which seem very self-reliant. JRCC Trenton reported rarely receiving any kind of distress in James Bay.

Nonetheless, our environmental scan found a significant amount of maritime traffic in James Bay. Further engagement for implementing SAR resources in James Bay, and discussion about the importance of communication with JRCC is suggested.

10. Summary of Findings

10.1 Summary of Incident Data Review and Analysis

- Hall Beach (n=7), Igloolik (n=4), Coral Harbour (n=2), Naujaat (n=2), James Bay Communities (n=1), Sanikiluaq (n=1), Puvirnituq (n=1), Kuujjuarapik (n=1), and Akulivik (n=1) are respectively the busiest communities of SAR Area 155 without Primary SAR Capacity.
- JRCC Trenton is most often contacted first (33%), followed by Nunavut EMO (24%).
- IRB-N would have covered 43.59 % of SAR Area 155 community-based maritime incidents involving pleasure crafts (total of 39 cases) if it had existed from 2012 to 2016.

- The month with the highest average number of marine cases for SAR Areas 010, 155 and 259 is August.
- JRCC Halifax averages 4.36 cases/community per span of five years while JRCC Trenton averages 1.79 cases/community.
- For every M1, JRCC is activated five times out of six in the Arctic.
- SISAR numbers are not accurate, especially for M2 and M3 cases. Most communities experience between four and five M2 or M3 incidents per year.
- There were 132 SAR cases (M1 to M3) in the Arctic from 2012 to 2016.
- Small craft are the most likely type of vessel to become involved in a marine incident.
- In communities with CCGA units, SAR incidents appear greater than in communities without.
- In SAR Area 155, 84% of the maritime response in the Arctic is by a vessel of opportunity, 23% being the Coast Guard.
- In SAR Area 155, from 2012 to 2016, local CCGA had a role in 4% of incident resolution

10.2 Risks Identified in Environmental Scan

- Small craft regularly transit 300-400nm between communities along exposed shorelines.
- James Bay is affected by large storm surges.
- The Hudson Lowlands offer minimal protection to boaters due to the lack of sheltered inlets, islands, and river mouths.
- Most small-craft waters are poorly charted and have numerous unmarked shoals
- Fog is prevalent in late summer

11. SAR Partner Engagement

SAR Operations Officers met with JRCC Trenton and Halifax, the Regional Operational Centre in Montreal, MCTS Iqaluit, and attended Mass Rescue Operations Workshops with numerous Arctic SAR partners and stakeholders to verify research findings. For SAR Area 155, engagement sessions were held in Coral Harbour and Naujaat to identify shared local hazards and boating trends.

12.Meeting the Coast Guard Performance Standard

According to the Coast Guard Levels of Service and Service Standards 2007, the Coast Guard has set a Performance Standard level of 90% of lives at risk being saved in conventional cases. The performance standard is expressed as a percentage and is calculated using the formula:

$$\frac{\textit{Lives Saved}}{\textit{Lives at Risk}} \times 100\% = \textit{Performance}$$

$$\textbf{Lives Saved} = (\textbf{\# people saved from imminent danger})$$
$$\textbf{Lives at Risk} = (\textbf{lives saved} + \textbf{lives lost} + \textbf{lives missing})$$

The table below in ***Table** 7* shows the total number of people involved in M1 and M2 cases only. M1/M2 cases may have a combination of people assisted, saved, lost and missing.

M3 cases are not considered when calculating the performance standard as no risk to life exists. Similarly, POB 'assisted' are not included as 'saved' because their lives were never at risk. A distress call can arise when just one person on-board a vessel is facing a life-threatening situation.

Table 7: 2012 – 2016 Coast Guard Performance Standard for Arctic (155)

Year	Number of POB (people onboard)	Number of POB Assisted	Number of POB Saved	Number of POB Lost	Number of POB Missing	Result %
2012	23	4	19	0	0	100.00
2013	8	0	8	0	0	100.00
2014	10	0	8	0	2	80.00
2015	23	0	23	0	0	100.00
2016	0	0	0	0	0	N/A
Totals	**64**	**4**	**58**	**0**	**2**	**96.67**

For the years of this analysis in Area 155, the Coast Guard failed to meet the performance standard during 2014. However, the Coast Guard has achieved an overall Performance Standard of 96.67%, which is above the acceptable standard of 90%.

As defined in the Canadian Coast Guard Level of Service - Service Standards, June 2004 - 90% effectiveness is expected to be achieved during "conventional incidents" in which:

a. *resources are able to respond within a short period of time;*
b. *the search object is located by the responding resource on scene in a timely manner;*
c. *environmental, geographic, and hydrographic conditions have little impact on the successful resolution of the incident; and*
d. *The responding resource has the necessary capability and capacity to effectively resolve the incident.*

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2018-19 Area Analysis of Mackenzie River, Northwest Territories, & Yukon (259)

Record of Amendments

#	Date	Description	Initials

Approvals

JEAN-SÉBASTIEN LANDRY AND JAMES HARE REGIONAL RAMSARD ANALYST	Recommended : JSL JH Date: 18/03/2019
STEVE THOMPSON DEPUTY SUPERINTENDENT, ARCTIC OPERATIONS	Approved : Date: 18-Mar-2018
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1 Recommendations

#	RISK	RECOMMENDATIONS
SAR AREA 259		
1.	**LACK OF SECONDARY SAR IN ACTIVE MARINE COMMUNITIES** • **Tuktoyaktuk (n=4), Inuvik (n=2), Paulatuk (n=1) and Kugluktuk (n=1)** are the most active communities of SAR Area 259. • CCGA responded to 2 of 8 incidents in Area 259 during a 5-year span	• Implement CCGA in Sachs Harbour and Paulatuk
2.	**HIGH POTENTIAL OF SMALL CRAFT TRAFFIC BETWEEN COMMUNITIES DURING THE SUMMER** • Small craft regularly transit 300-400 nm between communities along exposed shorelines	• Continue the implementation of CCGA units in Arctic communities through the OPP's CCGA Expansion and Community Boat initiatives • Increase the presence of Coast Guard SAR training officers in the Arctic • Increase the safety culture by leveraging CCGA presence via regional Boating Safety MOU with Transport Canada

3.	**LIMITED BOATING SAFETY / SAR INCIDENT STRATEGY IN THE ARCTIC** • Poor survival time of mariners in distress due to cold water • Elder and CCGA reported young people are being irresponsible with boating. Taking on higher risk, departing in poorer weather • Limited charts available in local communities for SAR planning	• Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly territorial governments • Sign regional MOU with Transport Canada to increase boating safety culture by leveraging CCGA • Recruit young people into CCGA, provide communities/hamlet offices an outlet to receive updates from JRCC during incidents • Fund Canadian Safe Boating Council campaigns such as Operation Life Preserver. Provide boater education on the effects of cold water, HELP position, and distribute life jackets and floater suits • Recommend expansion of the mandate of Canadian Safe Boating Council's Operation Life Preserver to include floater suits for northern mariners. • Distribute buoyancy tanks for installation in small craft so they do not sink when swamped/ capsized. • Chart to modern standards all small-craft navigable waters within 75 nautical miles of populated areas • MOU agreement between the Coast Guard and the Canadian Hydrographic Survey Resource for Arctic SAR Team to use charts as engagement gifts. They are more cost-effective than most options and far more sought-after by communities

4.	**HIGH RISK GROUNDING FROM PASSENGER VESSELS** • For passenger vessels, the most common issues are running aground due to poor navigation or charting. Examples include Clipper Adventurer (197 POB) in 2010, and Akademik Ioffe (162 POB) in 2018. • Russian Charts of the Canadian Arctic are considered more useful than Canadian Hydrographic Service resources • Recent ice conditions opens unexplored areas	• Chart all navigable waters within 200 nautical miles of populated areas • Improve or increase Canadian Hydrographic Survey Resources • Implementation of the Low Impact Shipping Corridors initiative. • Increase Coast Guard presence in the Arctic
5.	**COAST GUARD IS NOT ALWAYS NOTIFIED OF MARINE SAR CASES** • Many SAR incidents go unreported in the North • MCTS Iqaluit is not yet adjusted on instant communication for SAR incidents • Confirmation bias exists in SAR reporting: locals will only call government for help if they know the government is nearby • JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.	• Link Iqaluit MCTS services to community towers to offer services. It is recommended that steps be taken to allow MCTS Iqaluit to monitor community VHF towers for offering services such as sail plans, weather, issuing MARB's, and coordinating searches with JRCC. • Provide communities (via Hunters and Trappers Associations / Organizations) with loanable AIS/InReach/SPOT devices to minimize search time • Increase public awareness of JRCC and the SAR system (i.e., who to call, how it works) • During SAR incidents, provide communities / hamlet offices an outlet to receive updates from JRCC

		• Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly the territorial government
6.	**JRCC and MCTS – Lack of environmental data**	• Provide the Rescue Coordination Centre with data to account on ice drifts and characteristics when planning for searches.
7.	**JRCC and MCTS – Lack of position finding capability** • VHF in Arctic not equipped with RDF • No Cellular GPS Positioning Capabilities	• Increase MCTS RDF capabilities • Provide small craft with loanable AIS/InReach/SPOT devices to minimize search time • Provide JRCC general locations of cabins on shore, used by locals in the event of adverse weather conditions
8.	**JRCC and MCTS – Inuktitut deficiency** • Large number of Inuktitut-only speaking mariners, difficulty for locals to communicate with JRCC and MCTS	• Ensure 1 MCTS officer can translate Inuktitut to English • Ensure timely access to Inuktitut interpretation services in interim

2 Summary

In summary, the Canadian Coast Guard achieved its Performance Standard in SAR Area 260 in all five years under review (2012-2016).

Figure 1: Regions of risks identified in SAR Area 259

However, maritime risks still exist. To reduce the risk of a Search and Rescue incidents occurring in SAR Area 260, the mitigation measures presented at the beginning of this report are strongly recommended.

For that reason, after completing a thorough analysis of Area 260 the analysis team has come to the conclusion that:

A situation exists that requires immediate action.

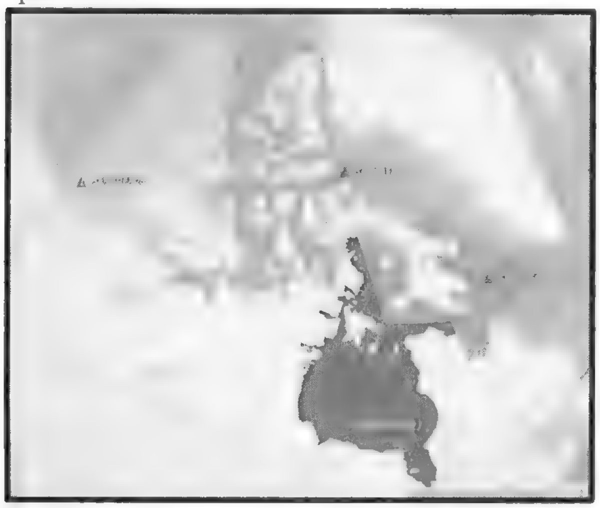
To mitigate the risk of injuries and lives lost due to marine SAR incidents, the recommendations in this report the team has chosen to highlight for further considerations are:

1. The continuation of CCGA implementation in Arctic communities
2. The establishment of a SAR prevention strategy adapted for northern climates

If implemented, the analysis team has concluded that the level of risk to the Coast Guard with regards to SAR delivery will be lowered and the Coast Guard Performance Standard results will improve.

3 Introduction

Due to the limited scope but large area under study – 50 % of the coastline of the country – this study did not have the intention to focus on regionally-specific challenges, like specific shipping channel navigational risks, specific implications of SAR in ice-breaking operations, or Arctic Mass-Rescue Scenarios, which are already taken care by Subject Matter Experts (SME). For this reason, the readers of this report should also consult experts at the Maritime Communications and Traffic Services Centre in Iqaluit, the Regional Operation Centre in Montreal, the Joint Rescue Coordination Centres in Trenton and Halifax, and Subject Matter Experts on Mass Rescue prior of making decisions affecting their Arctic operations.



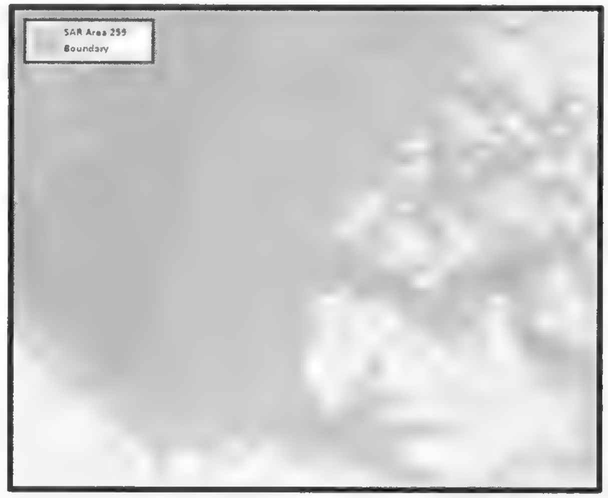


Figure 2 and 3 : Map of SAR Areas under review and Map of SAR Area 260

Areas 259, 260 and 155 are served by Joint Rescue Coordination Centre (JRCC) Trenton for coordination of maritime search and rescue (SAR). Area 010 is served by JRCC Halifax.

This document is a risk-based analysis of maritime SAR delivery in SAR Area 260 using data from 2012-2016. The purpose of this report is to identify the need for Coast Guard SAR assets using historical incident data and SAR partner engagement. Current SAR delivery will be assessed using the Canadian Coast Guard SAR Performance Standard.

SAR Area 259 encompasses the Inuvialuit Settlement Region located in the Western Arctic. The regional population is approximately 5495. The most commonly spoken languages are English and Inuvialuktun (Western Arctic dialect of Inuktitut). All details concerning wind, ice, tides, commercial and local maritime activities, and more, can be found in our environmental scan in **Annex C.**

Throughout the report, the analysis team started with an overview of the SAR Area, followed by a review of SAR incident data from the Coast Guard's System of Information on Search and Rescue (SISAR). This is followed by a summary of SAR engagement, and a section on primary SAR vessels and SAR incident response characteristics in relation to the Coast Guard Performance Standard for SAR.

4 Incident Data Review and Analysis

As per the Canadian Aeronautical and Maritime Search and Rescue (CAMSAR) manual, the definitions of the classifications of marine cases are as follows:

- ***M1* - Distress** – *A person or persons from a vessel are threatened by grave and imminent danger and require immediate assistance.*
- ***M1P* - Distress Reported After the Fact** – *An M1 case that has been resolved but would have required a response had the SAR system been alerted at the time of the case.*
- ***M2* - Potential Distress** – *The potential exists for an M1 case if timely action is not taken; i.e., immediate response is required to stabilize a situation in order to prevent distress.*
- ***M3*** - *A maritime situation other than an M1 or M2 case, where assistance is rendered to prevent case degradation to greater potential danger.*

4.1 Incident Analysis

Area 259 represents 6 communities averaging only 1.33 calls per community in a five-year span. As stated in our environmental scan (Annex C), the Mackenzie River Delta communities (Tuktoyaktuk, Inuvik, and Aklavik) are the busiest and most densely populated regions where tug boat movements, small-to-medium sized ferries, fishing, and recreational boating activities occur. Passenger vessels transit the area, typically two per year, often visiting Ulukhaktok.

From the SISAR data extraction, Tuktoyaktuk (n=4) was the busiest community followed by Inuvik (n=2), Paulatuk (n=1) and Kugluktuk (n–1).

Figure 4: Incident by Activity – SAR Area 259

4.2 Alerting method

In SAR Area 259, the main method of alerting for a pleasure craft is through RCMP or directly to MCTS Iqaluit. Of note is the absence of the Northwest Territory's Emergency Management Office in SAR alerting.

A strong relationship exists between RCMP and locals as most detachments include a marine unit which is able to respond to SAR taskings. This reinforces the concept that assets are only called upon when known about by locals. No Coast Guard presence equals fewer taskings sent to primary SAR assets.

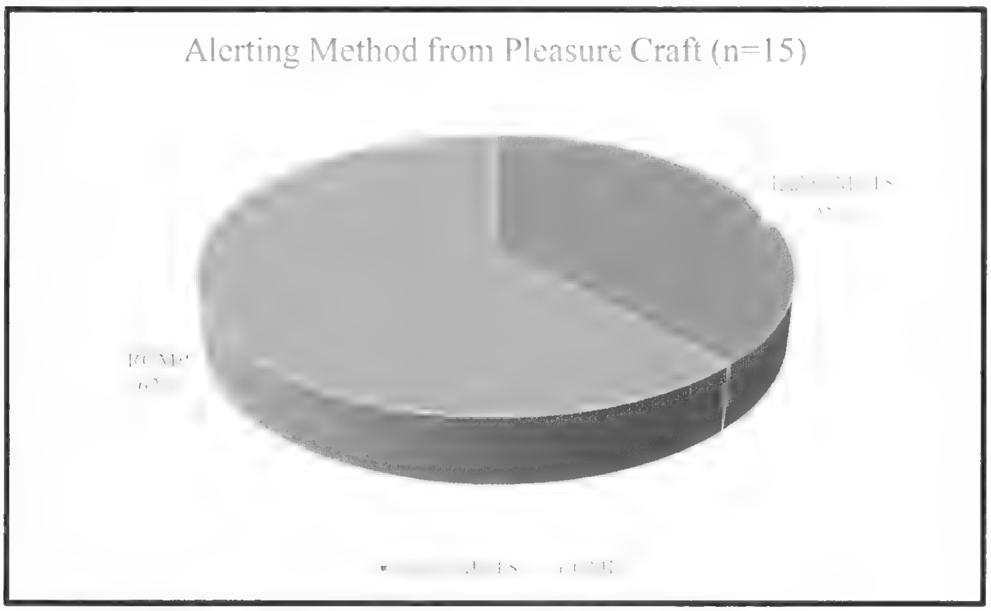


Figure 5: SAR Area 259 Method of Alerting for Pleasure Craft

No incidents involving fishing or commercial vessels were reported in SAR Area 259 for the period examined.

4.3 Monthly Distribution of M1 Cases

Figure 6 shows an overall picture of M1 cases that have occurred in SAR Areas 259, 260, 155 and 010. The results are generalized for the entire Arctic due to small data sets from individual SAR areas. SAR Area 260 had one M1 case; an overdue vessel.

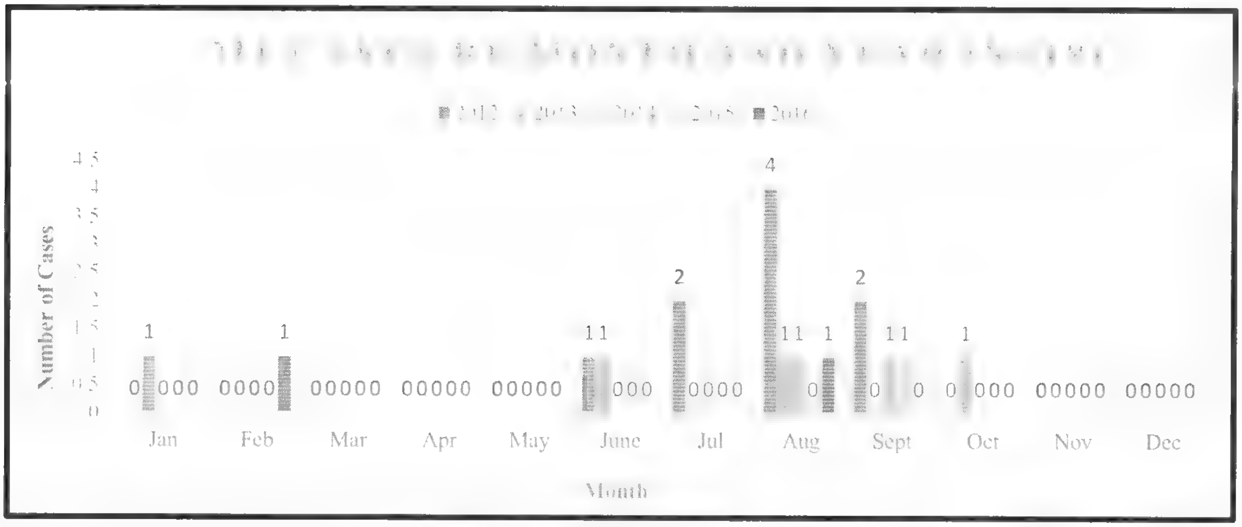


Figure 6: M1 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.4 Monthly Distribution M2 Cases

Figure 7 shows an overall picture of M2 cases that have occurred in SAR Areas 259, 260, 155 and 010. July (n=10), August (n=11) and September (n=9) saw the greatest number of M2 cases. Throughout the period examined, there were no M2 cases reported from December to May.

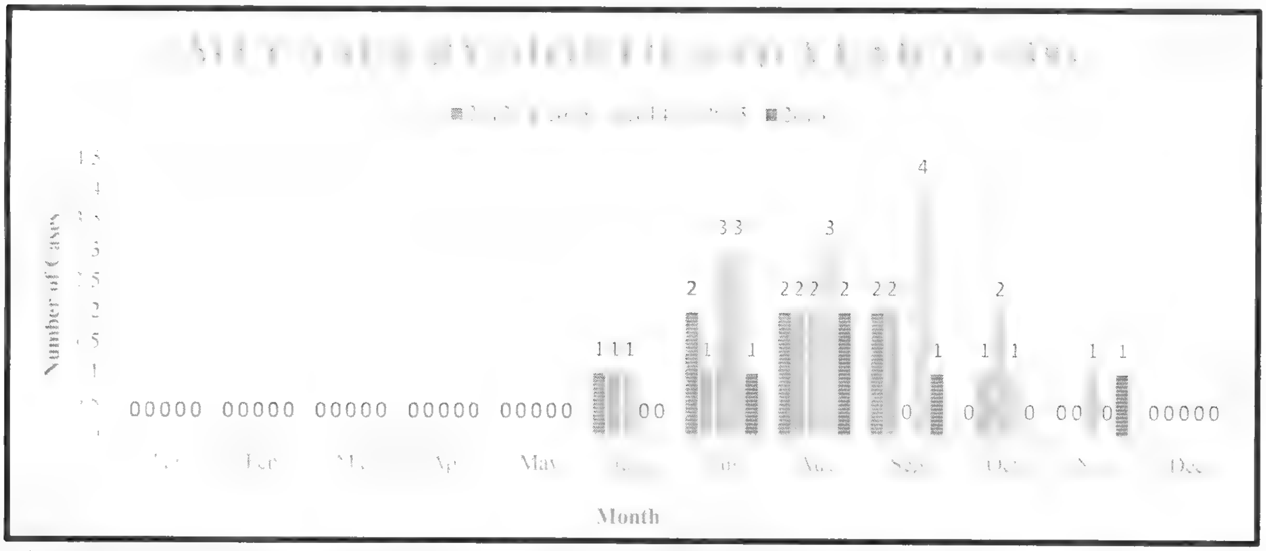


Figure 7: M2 SAR Cases by Month and Year for SAR Areas 259/260/155/010

4.5 Monthly Distribution M3 Cases

Figure 8 shows an overall picture of M3 cases that have occurred in SAR Areas 259, 260, 155 and 010.

The greatest number of M3 incidents occurred in August. M3 cases peak during the summer months with incidents extending earlier and later into the shoulder seasons, respectively.

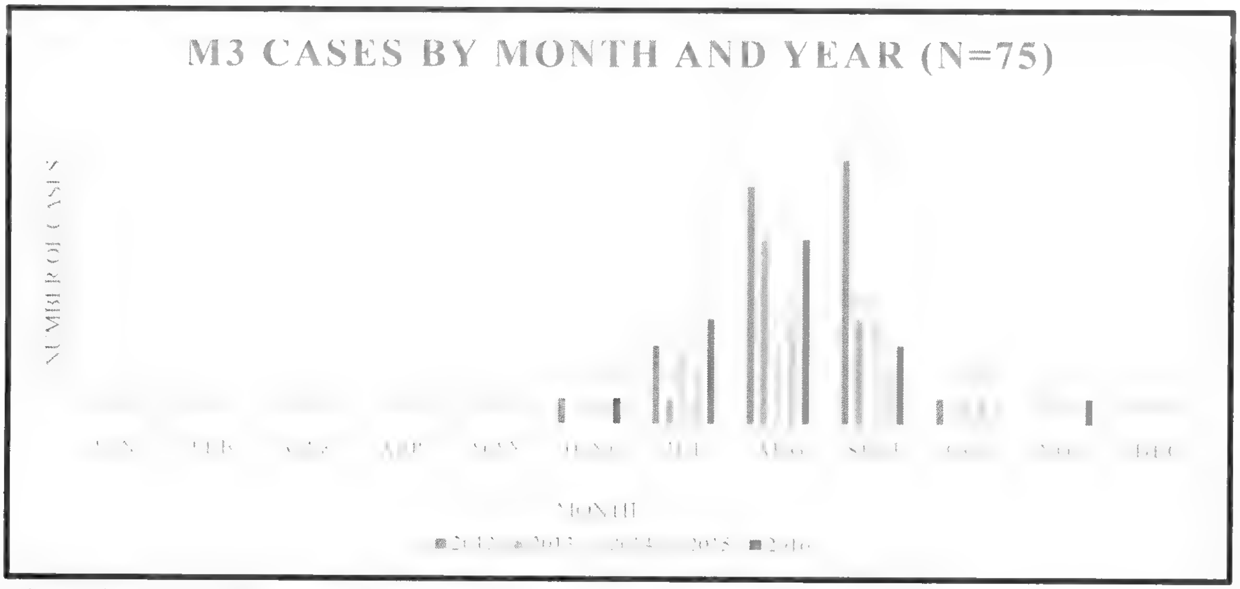


Figure 8: M3 SAR Cases by Month and Year for SAR Areas 259/260/155/010

5 Distribution of M1, M2, and M3 Cases

From 2012-2016; 75 M3 cases were reported to JRCC, 39 M2, and 18 M1 in all four arctic SAR Areas.

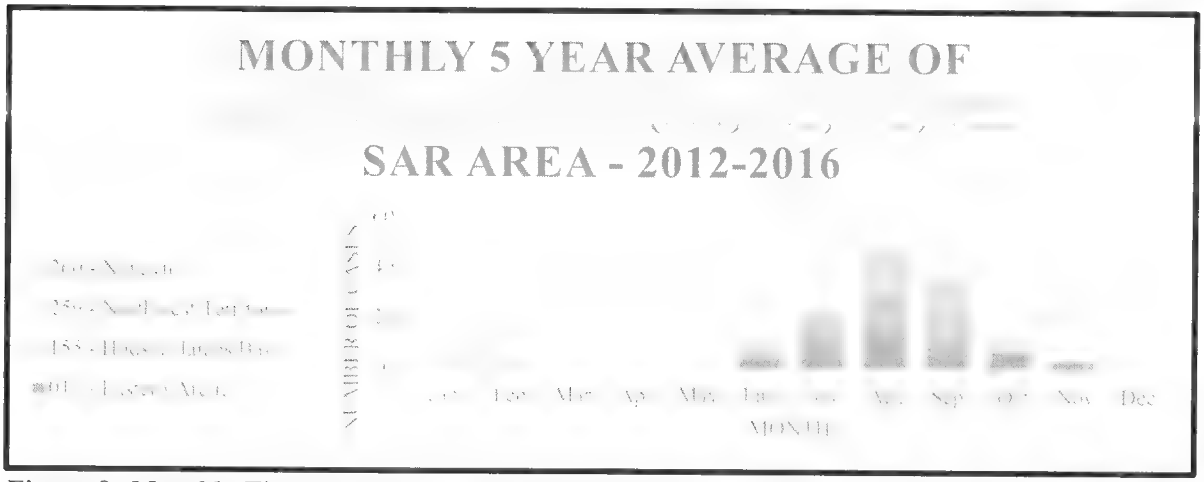


Figure 9: Monthly Five-Year Average of Marine SAR Cases (M1, M2, M3) by SAR Area 2012 - 2016

The month with the highest average number of marine cases for SAR Area 259 is August due to the high volume of seasonal pleasure craft, fishing vessels, and commercial traffic. Small craft can be found on the water at any time of year. If open water exists, Inuit are likely engaged in harvesting activities. Late summer is when M1 to M3 cases peak.

SAR Area 259 had 8 cases during the 5-year period of study.

Table 1: Number of cases per community 2012-2016

SAR Area	Number of communities	Number of cases	Total average (cases/community)
259	6	8	1.33

Through SAR partner engagement; it was identified that SAR statistics are underreported and the SAR case values presented in SISAR databases **do not capture all marine incidents**. From community engagement sessions; it was estimated that **the *actual* number of SAR cases that occur annually is <u>4-5 incidents per community</u>**. In SAR area 259, this represents between 15 to 18.75 times as many incidents occurring as are reported. Without providing a number, JRCC relayed the same picture of SAR underreporting. Wherever assets are not available, the federal SAR system is not activated, thus presenting as if such an area has no need for SAR resources.

It was pointed out during engagement sessions that each time the local SAR vessel is utilized in a community, it might not be to respond to what CCG would classify as a M1, M2, or M3. As an example,

sometimes a community will ask their local marine SAR unit to help transport kids to a traditional camp or significant Inuit cultural area to ensure safe passage. Tasking authorization for these type of SAR-prevention cases might be confusing or simply denied. For locals it could equally be hard to understand why such request might be refused by a primary SAR asset as there is a tangible benefit to local Inuit: improved safety for their kids.

6 Risk Matrix – Based on Five Years of Historical Data – 2012 to 2016

The risk portrayed in Figure 10 has been calculated using historical SISAR data from 2012 to 2016.

The criteria for determining how each category would be placed in the risk matrix (likelihood and impact) can be found in Tables 2 and 3.

Table 2 and 3 – Risk Matrix Likelihood Criteria and Risk Matrix Impact Criteria

Likelihood Legend		Range for likelihood number
Almost Certain	1 incident or more per week	52+
Likely	1 or more incident per month	11 to 51
Moderate	1 or more incident per year	1 to 11
Unlikely	1 incident every 10 years	0.1 to 0.9
Rare	1 incident every 25 years or more	0.04 to 0.09

Impact Legend	
Extreme	More than 50 at risk in incident.
High	More than 10 lives at risk in incident.
Moderate	More than 5 lives at risk in incident.
Low	One to five lives at risk in incident.
Negligible	No lives at risk in incident.

7 Risk Matrix – 2012 to 2016

The risk portrayed in ***figure 10*** has been calculated using historical SISAR data from 2012-2016.

Impact					
Extreme					
High					
Moderate					
Low			M1 Pleasure M2 Pleasure		
Negligible				M3 Pleasure	
	Rare	**Unlikely**	**Moderate**	**Likely**	**Almost Certain**
	Likelihood				

Figure 10: Risk Matrix – Area 010, 155, 259, 260

Overall, commercial vessels and fishing vessels have been omitted from this study as SAR Area 259 did not have any SAR cases involving commercial or fishing vessels for the period examined.

Our results are consistent with what would be expected. M3 cases have a greater likelihood of occurring than M2 and M1, with the latter having a greater impact when occurring.

8 Asset Response in Incident Resolution

In SAR Area 259, 27% of the maritime response in the Arctic (out of a possible 42%) is provided by a vessel of opportunity, 15% being by the Coast Guard.

The table (right) identifies SAR resources that responded when tasked for an M1, M2, or M3 incident by JRCC Trenton in area 259. It is common for multiple units to be tasked to the same incident, which is why there are 26 tasking during a time period where only 8 SAR cases are recorded.

SAR response relies heavily on all three types of air resources and 'other' marine resources. There are no primary SAR assets in SAR Area 259.

SAR incidents mostly happen near-shore and in close proximity to inhabited places. The M1 which occurred offshore was a small craft out of fuel. It drifted away from shore for several days before reported overdue. Location data is not available for all taskings in the 2012-2016 time period.

Table 4: Resources Tasked - SAR Area 259

Unit Tasked	*Number of Time Tasked*	*Source*
N/A	0	Primary Maritime SAR
Total	*0*	
CCG Ship Opportunity	4	
Federal Vessel	1	Secondary Maritime SAR
Total	*5*	
CCGA	2	
VOO Fishing	0	
VOO Commercial	1	Other - Maritime
VOO Pleasure	2	
Provincial Vessel	1	
Total	*6*	
CORM	0	
GRIF	0	Primary Air SAR
HERC	3	
Total	*3*	
Various CF Air	5	
CCG Air Opportunity	0	Secondary Air SAR
Federal Aircraft	0	
Total	*5*	
CASARA	4	
AOO Commercial	3	Other - Air
Private Aircraft	0	
Total	*7*	
Grand Total	*26*	

While engaging with JRCC Trenton, it was also highlighted most of the calls were down in the Mackenzie River, which is outside the area of this study. In the Mackenzie River, RCMP responds to the vast majority of the tasking, and JRCC rarely gets involved - except for delivering MCTS broadcasts or tasking Coast Guard ships, such as the CCGS Dumit or CCGS Eckaloo.

Figure 11: SAR Area 259 Incidents Locations

The following is a graphic depiction of the incident locations for SAR Area 259. Please note that there were no primary SAR SRU's in Area 259 from 2012 to 2016 and only 8% of incident resolution came from local CCGA (from a possible 42% for maritime response). In fact, the other 34% came in majority from Vessels of Opportunity (27%) – 15 % being the Coast Guard, and the other 12 % being commercial and pleasure crafts. While engaging with JRCC Trenton, the reliance on Vessel of Opportunity was mentioned and it was said that secondary marine resources, such as the CCG icebreakers, are often tasked to other assignments such as scientific research or resupplying a community.

9 Canadian Coast Guard Auxiliary in the Arctic

From 2012-2016, the Canadian Coast Guard Auxiliary (CCGA) was operating CCGA units in Tuktoyaktuk, Aklavik, and Inuvik. A new CCGA SAR Society was formed in Ulukhaktok in 2016. It became operational in 2018.

Figure 12: SAR Area 259 Incidents Locations

9.1 8.1 Number of Cases Answered by CCGA

JRCC tasked CCGA units to 2 of the 8 incidents in SAR Area 259 from 2012 to 2016. CCGA units have responded to one M1 case in this time period. Below is the breakdown for M1 incidents only.

Table 5: M1 Incidents by Type

Vessel Type	Fishing vessel	Commercial	Pleasure craft
M1 – Arctic	0	0	1

Limitations of CCGA assets exist due to the nature of their work. CCGA vessels are not required to maintain a 30 minute standby posture as they are not owned by the federal government. For this reason alone, such units are categorized as 'other' and do not count as primary or secondary SAR assets.

JRCC rarely coordinates searches in SAR Area 259. The RCMP is a co-signatory of an MOU with CCGA to ensure there is a SAR asset in most communities. This MOU expires in 2019 and is subject to end or be renewed by the signing parties.

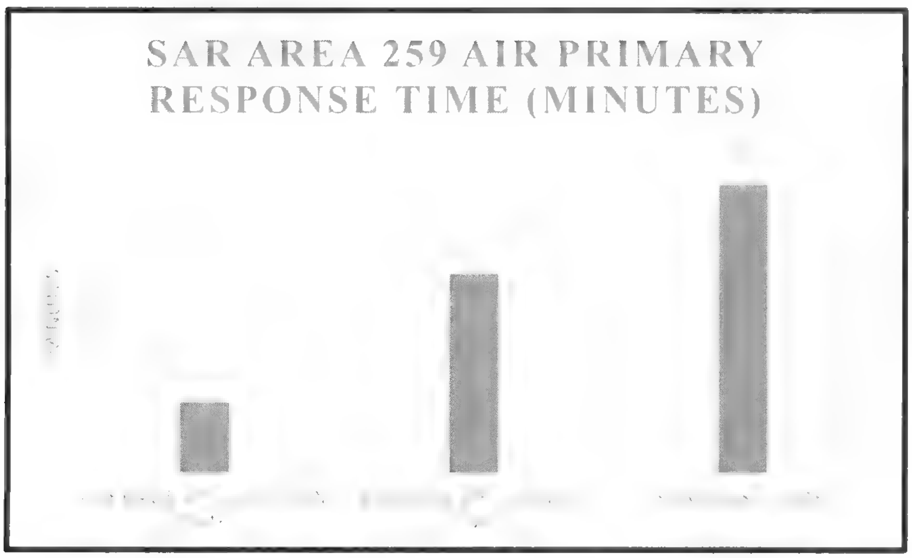
10 Resource Response Times

10.1 Air SAR Primary Response

The RCAF – Primary SAR Aircraft are the only primary SAR asset tasked at least once in the Arctic from 2012 to 2016. Hercules are able to conduct longer flights and act as a platform for SAR techs to launch from and stabilize a situation. Griffons are used for hoisting operations.

Table 6: SAR Area 259 – JRCC Trenton

Type	# Available	Mandated Reaction Time	Fuel Endurance	Crew	Crew Schedule
CC130 Hercules (424 and 435 Squadrons)	2	30 min. between 8-4 on weekdays, 2 hrs after hours and on weekends	11 hr.	7 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time



Reaction Time: Time from assignment of tasking to SRU departing base.
Transit Time: Time from departing base to on-scene.
Response Time: Reaction + Transit time.

Figure 13 : SAR Area 259 Air Primary Response Time (Minutes)

10.2 Secondary, Other, and Vessel of Opportunity Response

Figure 9.2.1 includes all tasking's issued by JRCC for marine cases during the years of the analysis. This section will discuss all 'Other' SRUs that were utilized from 2012-2016 to respond.

According to CAMSAR:

- ***Secondary Units*** – are all units of the Federal government that are not primary search and rescue units but which may be tasked to aid in the resolution of a search and rescue incident.
- ***Other Units*** – units, other than primary or secondary search and rescue units, which participate in search and rescue activities when required.

Other Units includes civilian agencies, volunteers and partially Federal Government funded facilities such as the Canadian Coast Guard Auxiliary and the Civil Air Search and Rescue Association.

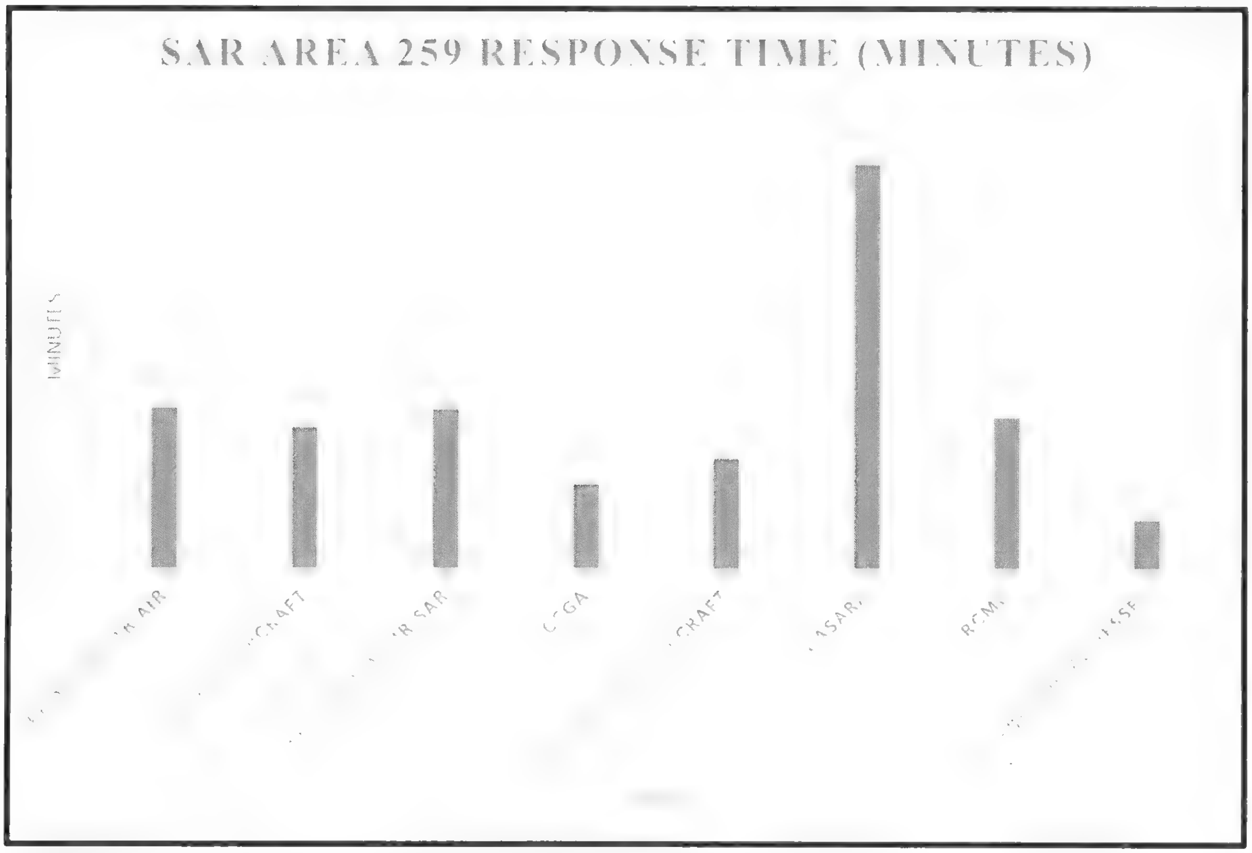


Figure 14: Area 259 Average Response Time (2012 – 2016)

11 Summary of Findings

11.1 Summary of Incident Data Review and Analysis

- There were to 132 SAR cases (M1 to M3) in the Arctic from 2012 to 2016.
- 100% of all M1 to M3 cases in SAR Area 259 are for disabled, overdue, stranded or grounded pleasure crafts.
- Tuktoyaktuk (n=4), Inuvik (n=2), Paulatuk (n=1) and Kugluktuk (n=1) are the most active communities of SAR Area 259.
- For every M1, JRCC is activated five times out of six in the Arctic.
- SISAR numbers are not accurate, especially M2 and M3. Most communities experience between four and five M2 or M3 incidents per year.
- In SAR Area 259, 64% of the maritime response in the Arctic is by a vessel of opportunity, 36% being the Coast Guard.
- In SAR Area 259, local CCGA had a role in 8% of incident resolution

11.2 Risks Identified in Environmental Scan

- Small craft regularly transit 300-400nm between communities along exposed shorelines.
- The Amundsen Gulf is used by all vessels transiting the Northwest Passage. It is obstructed by ice one in every ten years due to the Beaufort Gyre (clockwise rotating ice mass) pushing ice southward along Banks Island and obstructing any through-traffic for the entire season.
- The Mackenzie River Delta communities (Tuktoyaktuk, Inuvik, and Aklavik) are the busiest and most densely populated regions where tug boat movements, small-to-medium sized ferries, fishing, and recreational boating activities occur.

12 SAR Partner Engagement

SAR Operations Officers met with JRCC Trenton and Halifax, the Regional Operational Centre in Montreal, MCTS Iqaluit, and attended Mass Rescue Operations Workshops with numerous Arctic SAR partners and stakeholders to verify research findings.

13 Meeting the CCG Performance Standard

According to the CCG Levels of Service and Service Standards 2007, the CCG has set a Performance Standard level of 90% of lives at risk being saved in conventional cases. The performance standard is expressed as a percentage and is calculated using the formula:

$$\frac{\textbf{Lives Saved}}{\textbf{Lives at Risk}} \times 100\% = Performance$$

$$\textbf{Lives Saved} = (\textbf{\# people saved from imminent danger})$$
$$\textbf{Lives at Risk} = (\textbf{lives saved} + \textbf{lives lost} + \textbf{lives missing})$$

The table below in ***Figure 6.1*** shows the total number of people involved in M1 and M2 cases only. M1/M2 cases may have a combination of people assisted, saved, lost and missing.

M3 cases are not considered when calculating the performance standard as no risk to life exists. Similarly, POB 'assisted' are not included as 'saved' because their lives were never at risk. A distress call can arise when just one person on-board a vessel is facing a life-threatening situation.

Table 7: 2012 – 2016 CCG Performance Standard for Arctic (259)

Year	Number of POB (people onboard)	Number of POB Assisted	Number of POB Saved	Number of POB Lost	Number of POB Missing	Result %
2012	7	0	7	0	0	100.00
2013	0	0	0	0	0	NA
2014	0	0	0	0	0	NA
2015	0	0	0	0	0	NA
2016	3	0	3	0	0	100.00
Totals	**10**	**0**	**10**	**0**	**0**	**100.00**

For the years of this analysis in Area 259, the CCG has achieved a Performance Standard of 100 %. **This is above the acceptable standard of 90%.**

As defined in the Canadian Coast Guard Level of Service - Service Standards, June 2004 - 90% effectiveness is expected to be achieved during "conventional incidents" in which:

a. *resources are able to respond within a short period of time;*
b. *the search object is located by the responding resource on scene in a timely manner;*
c. *environmental, geographic, and hydrographic conditions have little impact on the successful resolution of the incident; and*
d. *the responding resource has the necessary capability and capacity to effectively resolve the incident.*

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Annex C: Environmental Scan

SAR Area 259

Maritime Search and Rescue Arctic Analysis

Canadian Coast Guard
Search and Rescue Risk Analysis
March 2019

Annex C: Environmental Scan – Area 259

The Regional SAR Risk Analysts for the Arctic would like to extend acknowledgement for this Environmental Scan to the following organizations:

Canadian Hydrographic Service
Canadian Ice Services
Department of Fisheries and Oceans
Environment and Climate Change Canada
Joint Rescue Coordination Centre Trenton
National Oceanic and Atmospheric Administration
National Aeronautics and Space Administration
Oceans Ltd

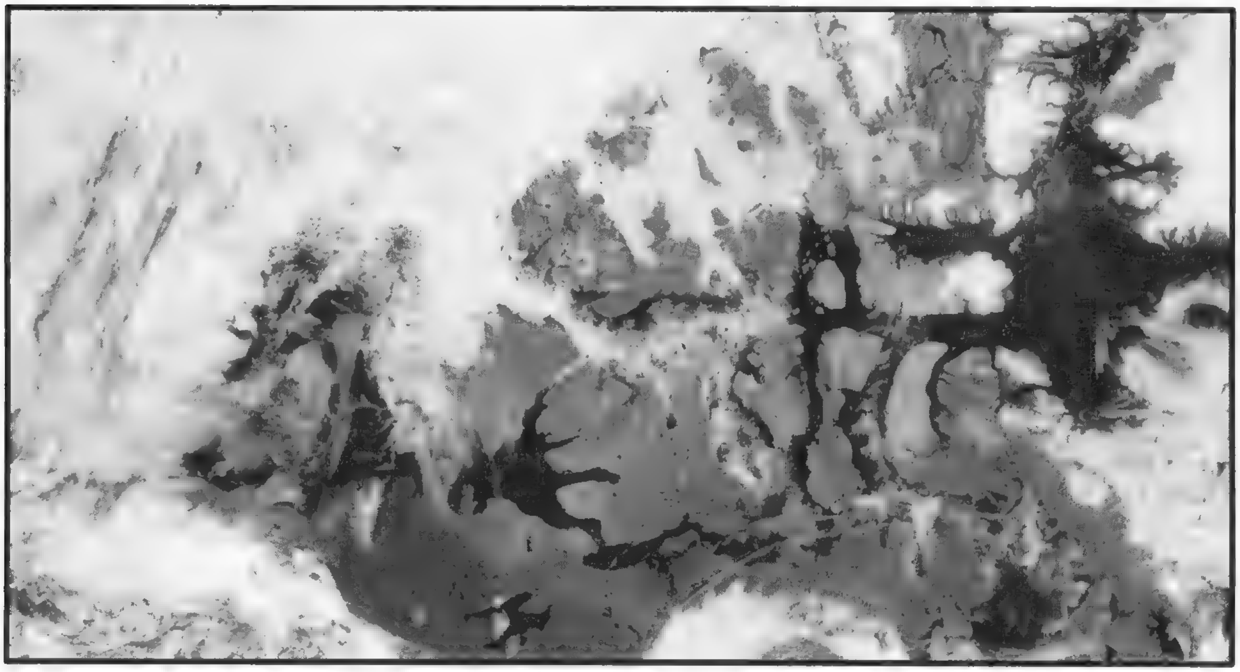

Figure 1 – Composite satellite imagery of prominent features in SAR Area 259

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Annex C: Environmental Scan – Area 259

Executive Summary

Search and Rescue (SAR) Area 259 underwent a Search and Rescue Risk Analysis (SARRA) Study using the Risk Based Analysis of Maritime SAR Delivery (RAMSARD) Methodology to study climate, geography, demographics, and human activity in the Arctic. The Environmental Scan is an important aspect of the risk analysis process and was designed to help evaluating risks to mariners in Search and Rescue areas on Coast Guard mandated waters. Environmental scans can help the Canadian Coast Guard (CCG) shape its resource management plans in response to rapids changes and create a vision of future requirement.

Summarized findings

- ❖ Arctic ice pack in the Beaufort Sea gyre melts in an east-northeast direction and often leaves large multiyear ice floes congesting Amundsen Gulf and Sachs Harbour into September.
- ❖ The Mackenzie River Delta communities (Tuktoyaktuk, Inuvik, and Aklavik) are the busiest and most densely populated regions where tug boat movements, small-to-medium sized ferries, fishing, and recreational boating activities occur.
- ❖ Tug boats are the main method of moving goods and resources between communities during the boating season. Inuvik and Tuktoyaktuk are the two main tug vessel hubs, both have road access.
- ❖ Ulukhaktok is visited by two cruise ships in a typical year, the community has minimal services.
- ❖ Herschel Island is a fixation for cruise ships and local tour companies, where small craft are known to travel 150 nautical miles offshore to reach the island.

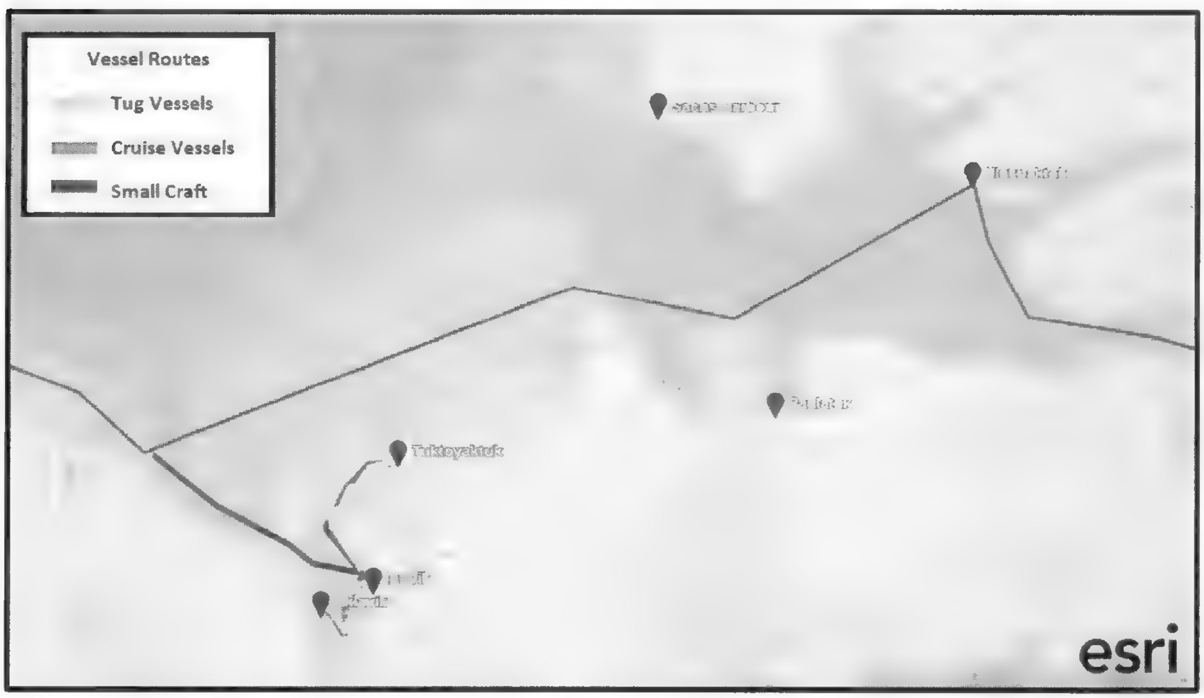


Figure 2 – SAR Area 259 Overview

1. Maps of SAR Area

1.1 Maps

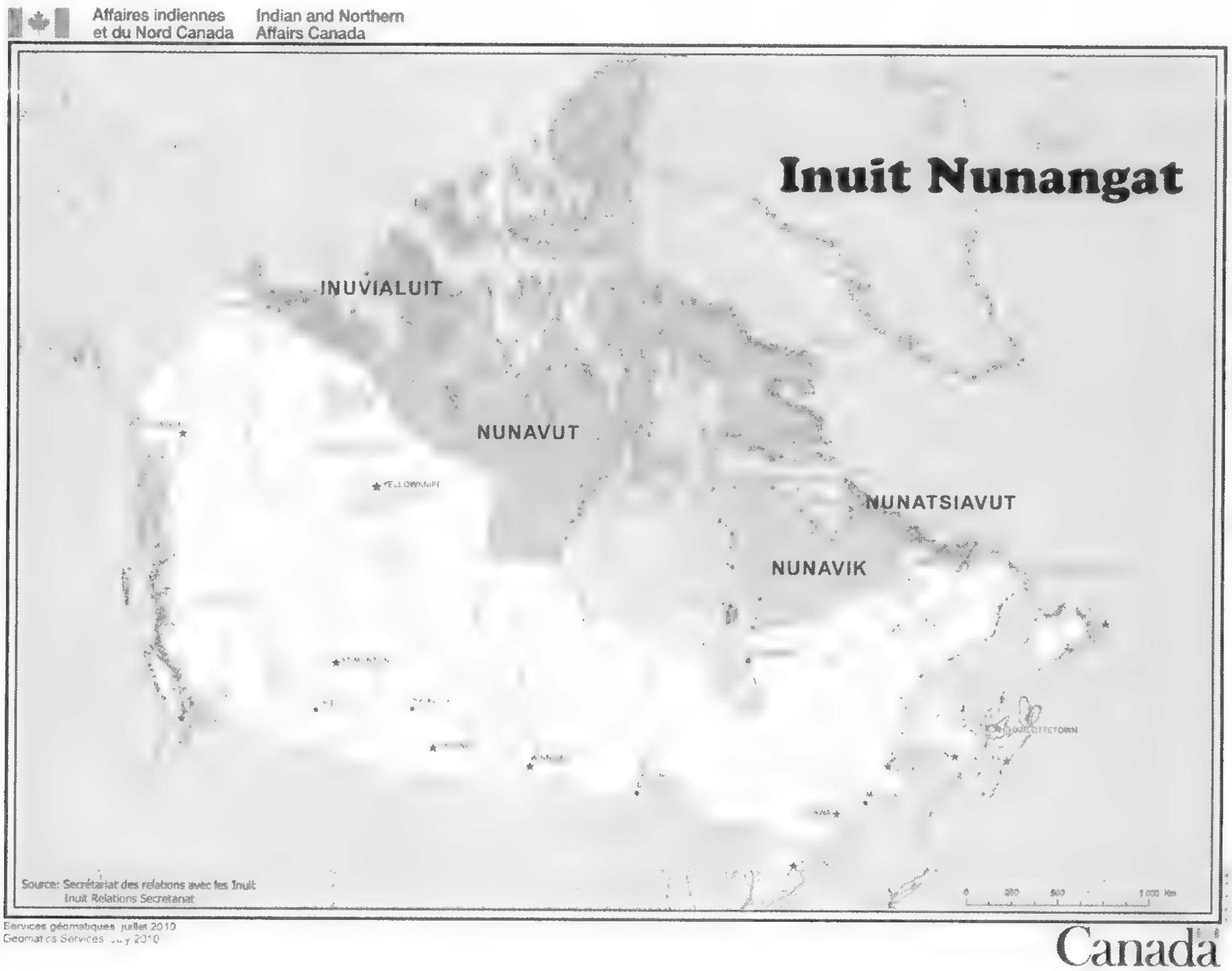


Figure 3 – Inuit Nunangat of Canada

Annex C: Environmental Scan – Area 259

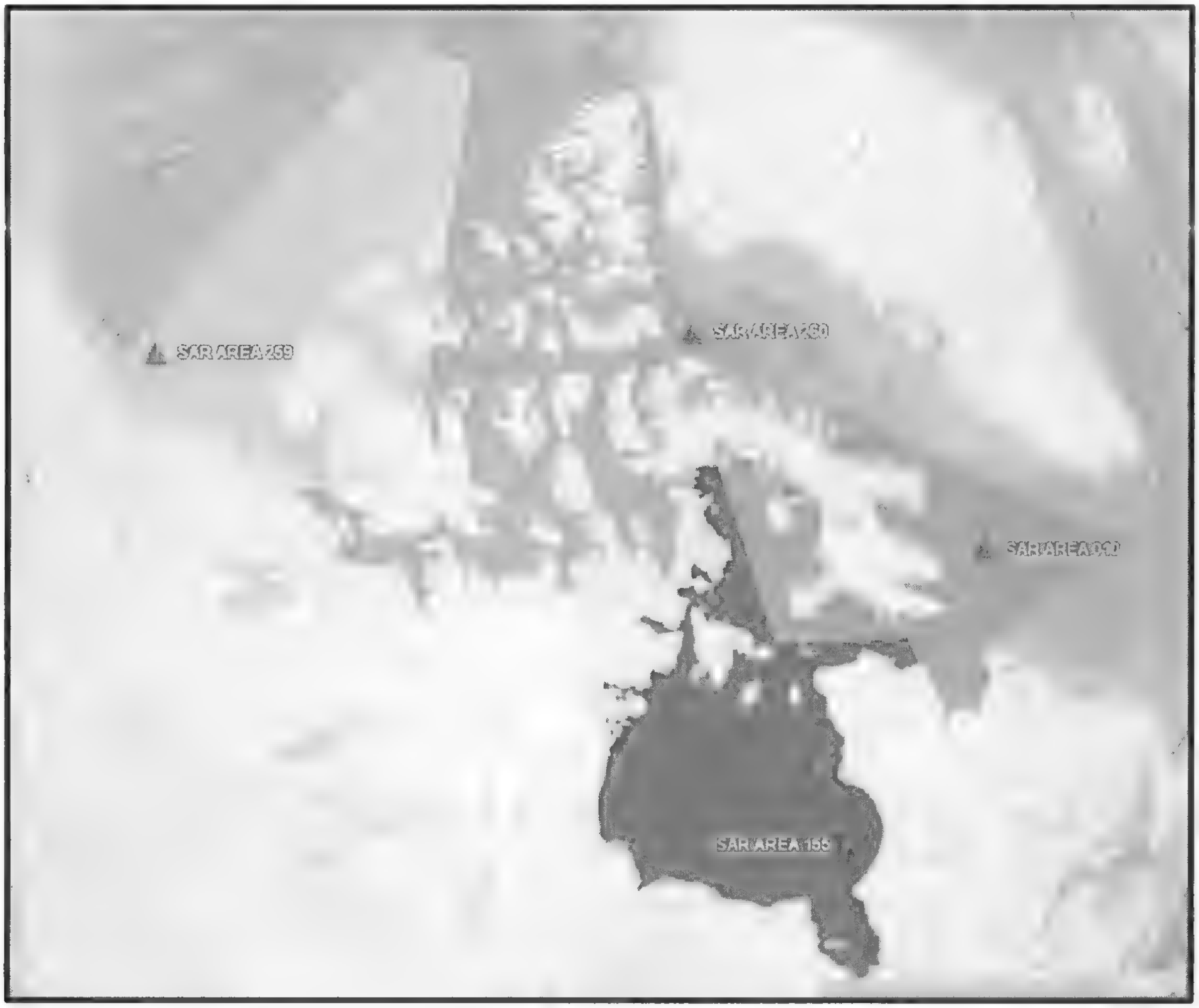


Figure 4 – RAMSARD defined regions of study. The Arctic includes 010, 155, 259, and 260. These are the boundaries for maritime SAR.

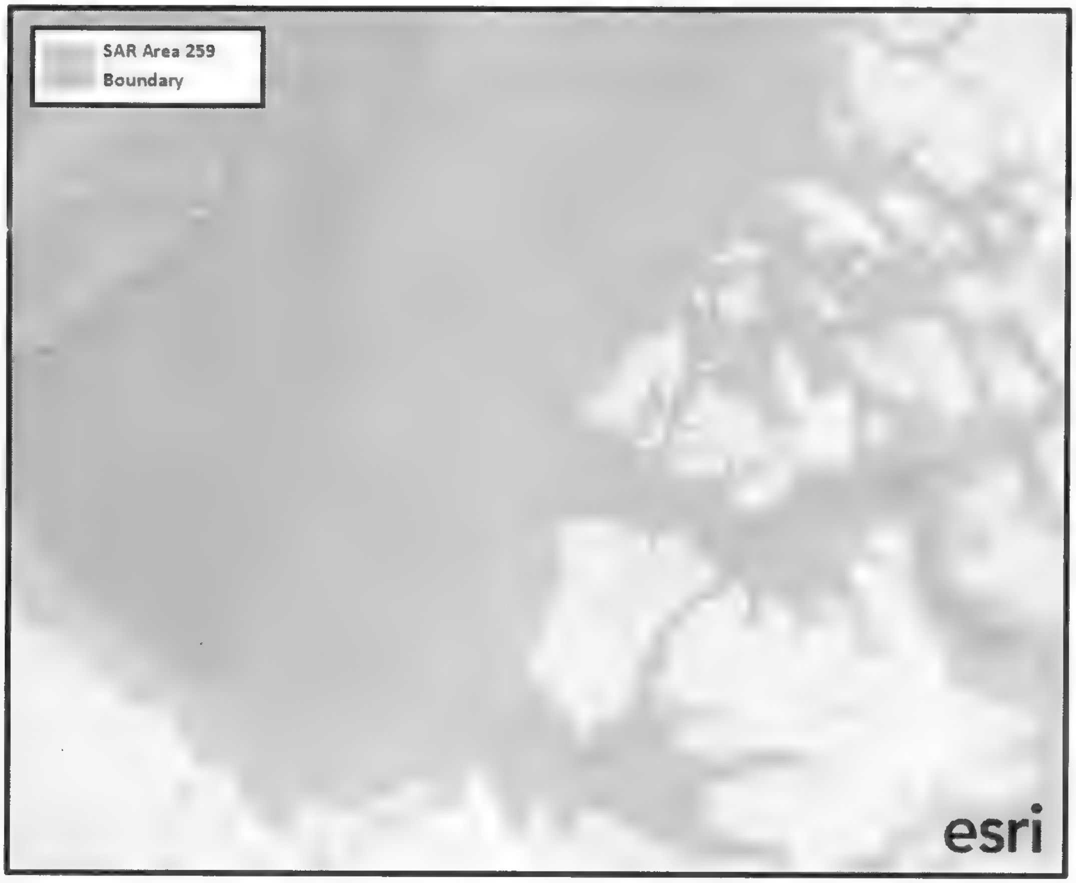


Figure 5 – Marine Portion of SAR Area 259

1.2 Description of Dimensions & Distances

SAR Area 259 encompasses all land and water areas of the Northwest Territories as well as the Arctic Ocean up to 141°W (Yukon – Alaska border) in the Canadian Arctic Archipelago. The area encompasses 1.2 million km^2 of ocean.

Prominent features of the Inuvialuit Nunangat include Victoria Island, Banks Island, Aulavik National Park, Melville Island, Prince Patrick Island, and Prince of Wales Strait. The area does not include rivers and lakes in the interior of Yukon Territory.

The Arctic region encompasses the six Inuvialuit communities: Inuvik, Aklavik, Paulatuk, Tuktoyaktuk, Ulukhaktok and Sachs Harbour. This report also includes Yellowknife, Hay River, and Norman Wells further upstream on the Mackenzie River.

The Joint Rescue Coordination Centre in Trenton, ON is responsible for SAR coordination in this SAR Area.

2. Climatology & Oceanography

Numerous climate factors are significant to the SAR program. The examination of climate by season in each SAR Area are conducted using 30 year climate normals for parameters including: prevailing wind direction, mean seasonal and maximum wind speed, percentage frequency of wave height greater than 2.0 metres, mean air temperature, mean seasonal minimum sea surface temperature, percentage frequency of visibility less than 1 nautical mile, percentage of fog occurrence, mean seasonal maximum of current speed, mean seasonal sightings of icebergs, mean days per season of ice coverage with concentration greater than 7/10ths and thickness greater than 15 cm, and presence of old ice and first-year ice.

For the purpose of this Environmental Scan, the seasons are defined as:

- Winter – December, January, February
- Spring – March, April, May
- Summer – June, July, August
- Fall – September, October, November

2.1 Prevailing Wind Direction

Prevailing wind direction in SAR Area 259 is from the East.[1] Storms affecting the area typically form over the North American continent and North Pacific, where they routinely track from West to East (in the opposite direction of prevailing wind). Storms are more prevalent in autumn and winter.

Figure 6 – Prevailing wind direction in SAR Area 259

Low pressure systems are uncommon over the Beaufort Sea during summer. High Arctic systems follow irregular tracks when over ocean. Summer storm tracks tend to avoid the populated areas along the North

[1]Oceans ltd. (2018). *Climate of the Canadian Coast Guard SAR Areas*

shore of NWT in Amundsen Gulf. Autumn storm tracks develop more uniformly and approach from the West.

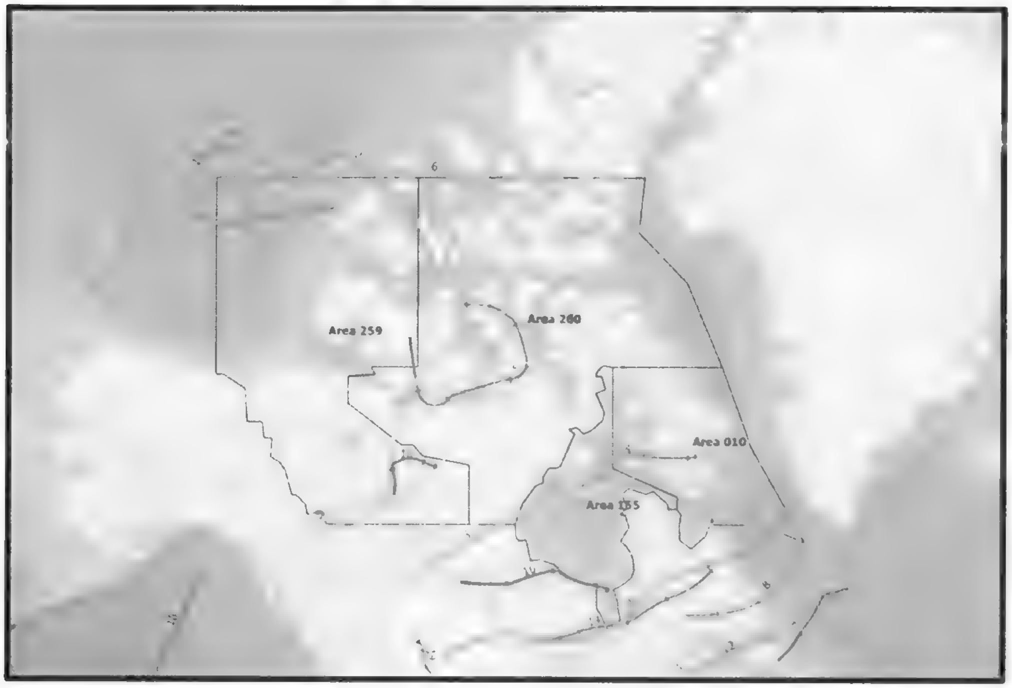


Figure 7 – Summer Storm Tracks

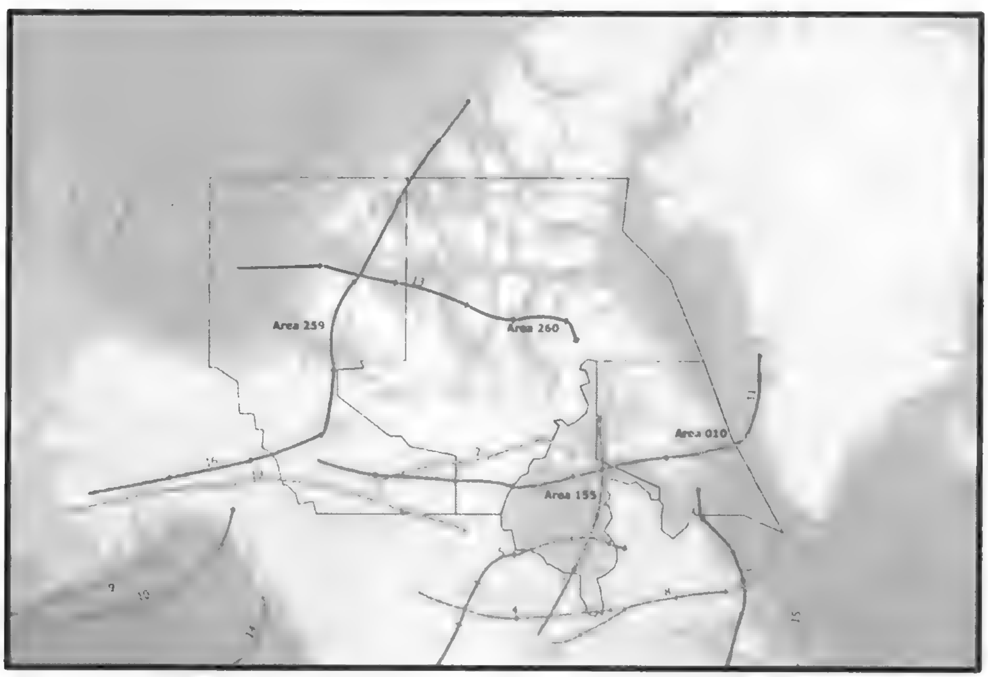
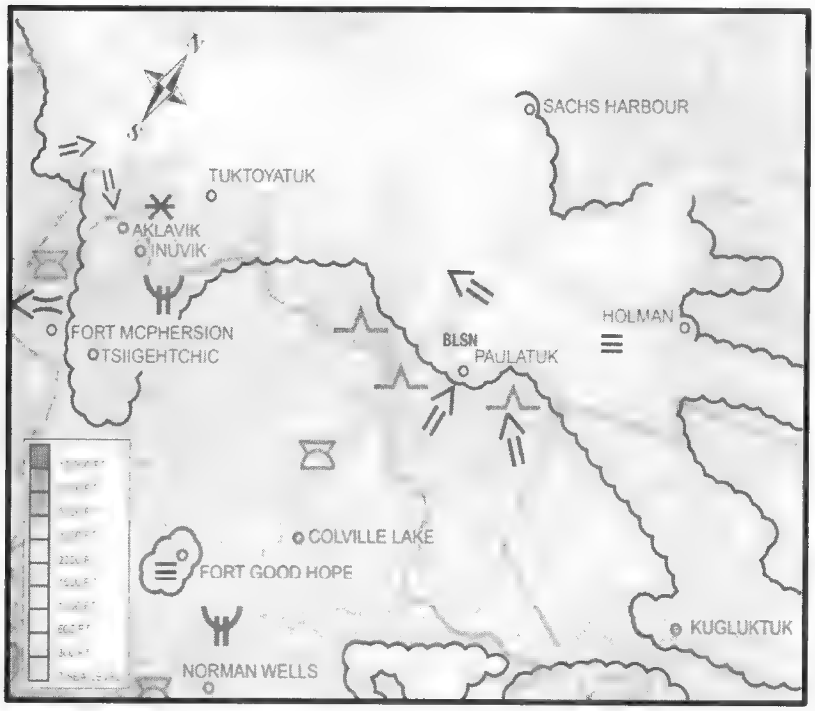


Figure 8 – Autumn Storm Tracks

Annex C: Environmental Scan – Area 259

The presence of costal features significantly influences local wind conditions. Katabatic outflow winds are common given the topography of large islands in the area. Strong localized offshore winds result in unusual ice characteristics where floes are kept away from shore, leaving open water. Summer wind conditions are relatively light while the autumn boating season sees worsening conditions.



NAV Canada Symbols	
Low Cloud Cover	
Prevailing Winds	
Funneled Winds	
Fog	
High precipitation	

Note: Symbols depicted on map are for aviation use and some have not been included in the scope of this report.

Figure 9 – Local Winds and Fog in Area 259

Table 1 – Mean Seasonal Wind Speed

Season	Mean	Mean Maximum
Winter	11.8	30.5
Spring	11.2	26.8
Summer	10.2	25.0
Autumn	13.3	31.3

2.2 Waves

Typical annual wave height is 0.0 – 1.0 metres from the east, increasing to 1.0 – 2.0 metres during autumn. The next table illustrates the percentage frequency of wave height greater than 2.0 meters from 1981 to 2010.

Table 2 – Percentage Frequency of Wave Height Greater than 2.0m and 4.0m

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	n/a	n/a
Spring	n/a	n/a
Summer	4.8	0.1
Autumn	23.9	2.0

Waves do not develop in winter and spring as old ice prevents wind from interacting with the surface of the ocean.

Swell does not affect marine activity in this SAR Area. Pack ice, along with nearby offshore winds result in little opportunity for ocean swell to develop. Additionally, much of the boating activity in the region occurs in the Mackenzie River delta, where swell and waves are negligible. As such, swell of any kind rarely forms in SAR Area 259.

Table 3 – Percentage Frequency of Swell Wave Height Greater than 2.0 metres

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	n/a	n/a
Spring	n/a	n/a
Summer	0.1	0.0
Autumn	0.6	0.0

2.2.1 Beaufort High Pressure Systems and Swell

The Beaufort Sea north of the Mackenzie River Delta is often home to a high pressure air mass system. This clockwise-rotating system drives the easterly winds throughout the SAR Area and deflects storms away from the Northern coast of Yukon and NWT.

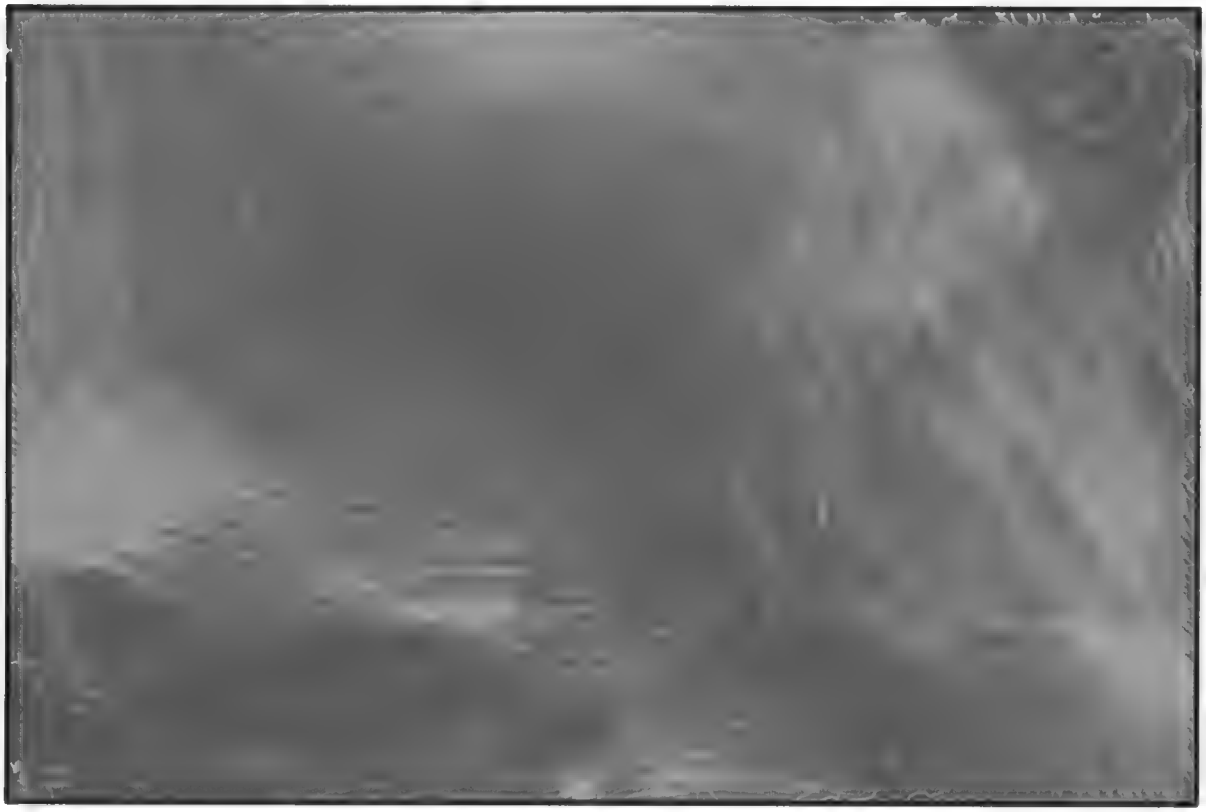


Figure 10 – Surface winds captured on 2018-08-23 show a high pressure system over the Beaufort Sea

2.3 Temperatures

2.3.1 Seasonal Air Temperature (°C)

Air temperature in SAR Area 259 is closely linked with the albedo effect (degree to which a surface reflects incident radiation or light) of snowpack & ice, daylight hours, and sea surface temperature. The climate of SAR Area 259 is defined as polar (E) according to the Köppen–Geiger climate classification system. The Polar Region has two climate, the Tundra climate (ET) and the Ice cap climate (EF). The Tundra climate is classified as having mean monthly temperatures rise above 0°C for part of the year without exceeding 10°C while the Ice cap climate has eternal winter with all 12 months of the year with average temperatures below 0° C.

Communities near the Mackenzie River experience a Sub-Polar climate, defined as a region experiencing mean monthly temperatures rising above 10°C at least one month of the year.

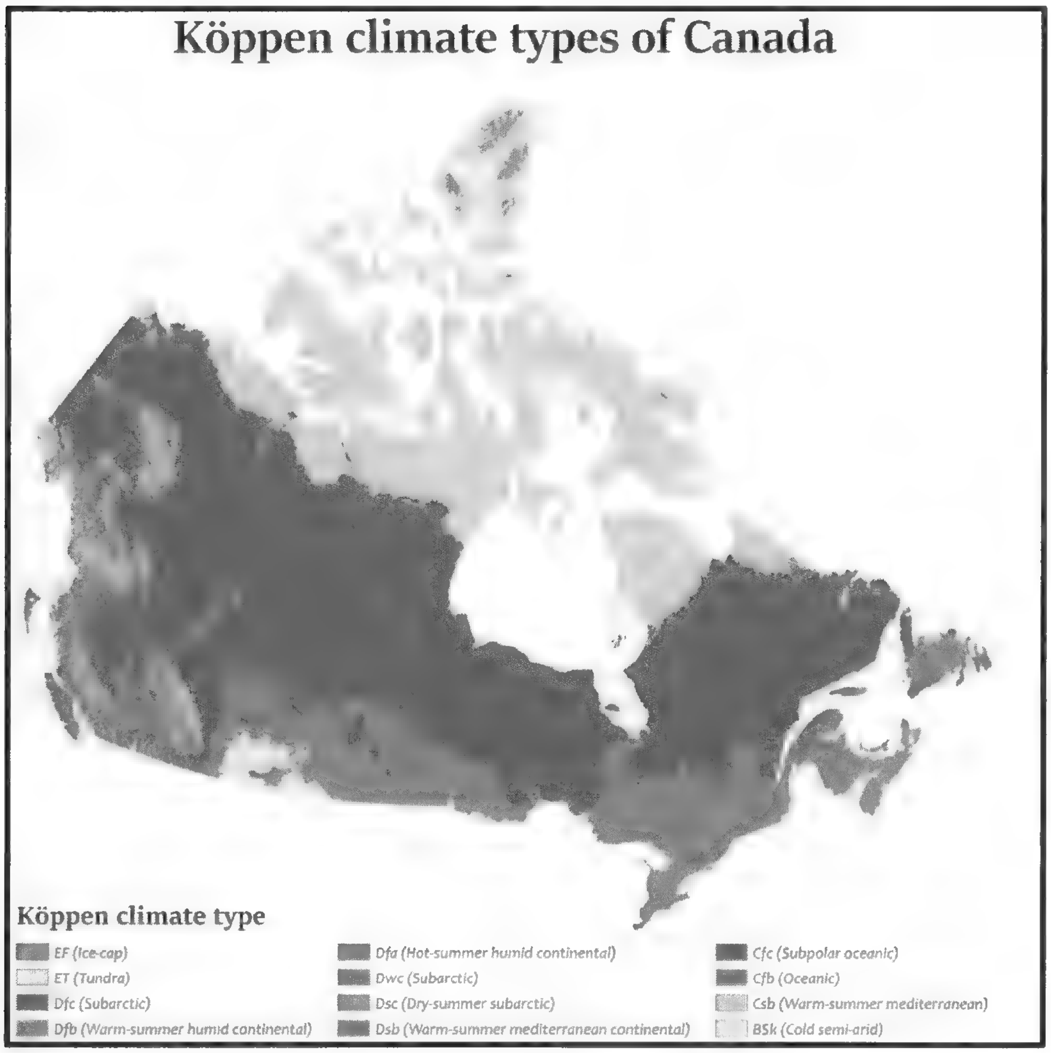


Figure 11 – Climate Regions of SAR Area 259

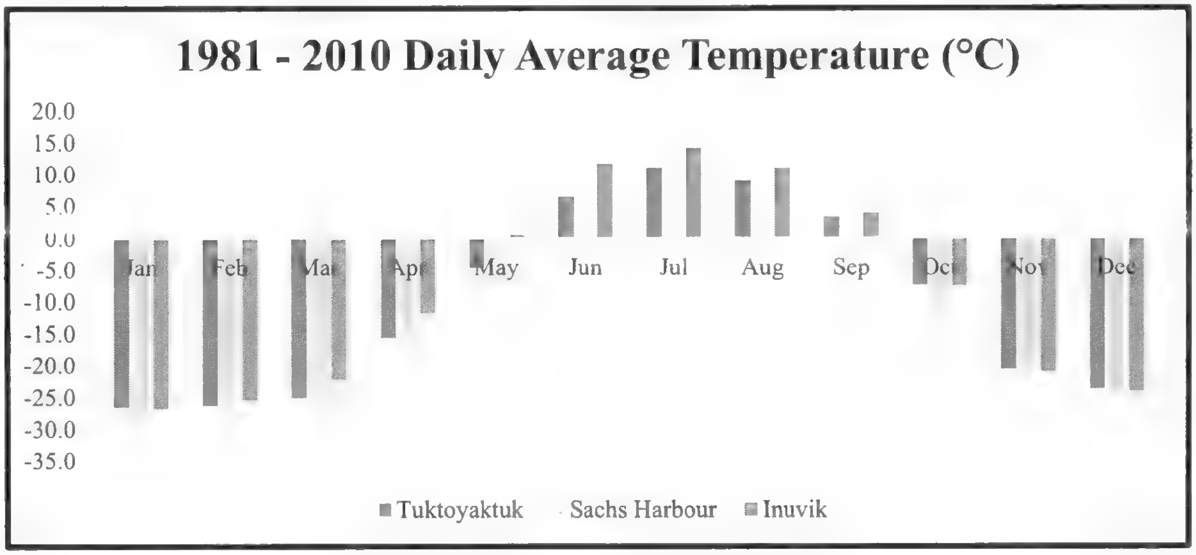


Figure 12 – Daily Average Temperatures in Select Communities of SAR Area 259

The seasonal variation of sea-surface temperatures in the Canadian shows a significant gradient. Data is not collected in winter as all of SAR Area 259 freezes into thick first year ice, where sea surface temperatures beneath the ice hover at -1.6°C. Sea surface temperature reporting was incomplete and had a large standard deviation in data sets for SAR Area 259. Water temperatures vary widely due to the diverse range of maritime conditions created by lakes, rivers, tides, shallow ocean areas, and icebound waterways. Hypothermia poses a significant hazard to mariners at any time of year.

2.3.2 Seasonal Sea Surface Temperatures[2] (°C)

Table 4 – Mean seasonal minimum and maximum sea surface temperature (in degrees Celsius)

Season	Minimum	Maximum
Winter	n/a	n/a
Spring	n/a	n/a
Summer	-0.5	14.4
Autumn	-1.4	7.8

[2] As recorded at Beaufort Grid Point 001329 located at 71.25°N; 135.75°W

2.4 Sea Ice

Ice break up dates in SAR Area 259 are characterized by early shore fast ice dispersion near the Mackenzie River while remaining ice clings to Victoria and Banks Island. Late in the season, a navigable route is established through to the Beaufort Sea with old ice enveloping the remainder of the Arctic Ocean year round.

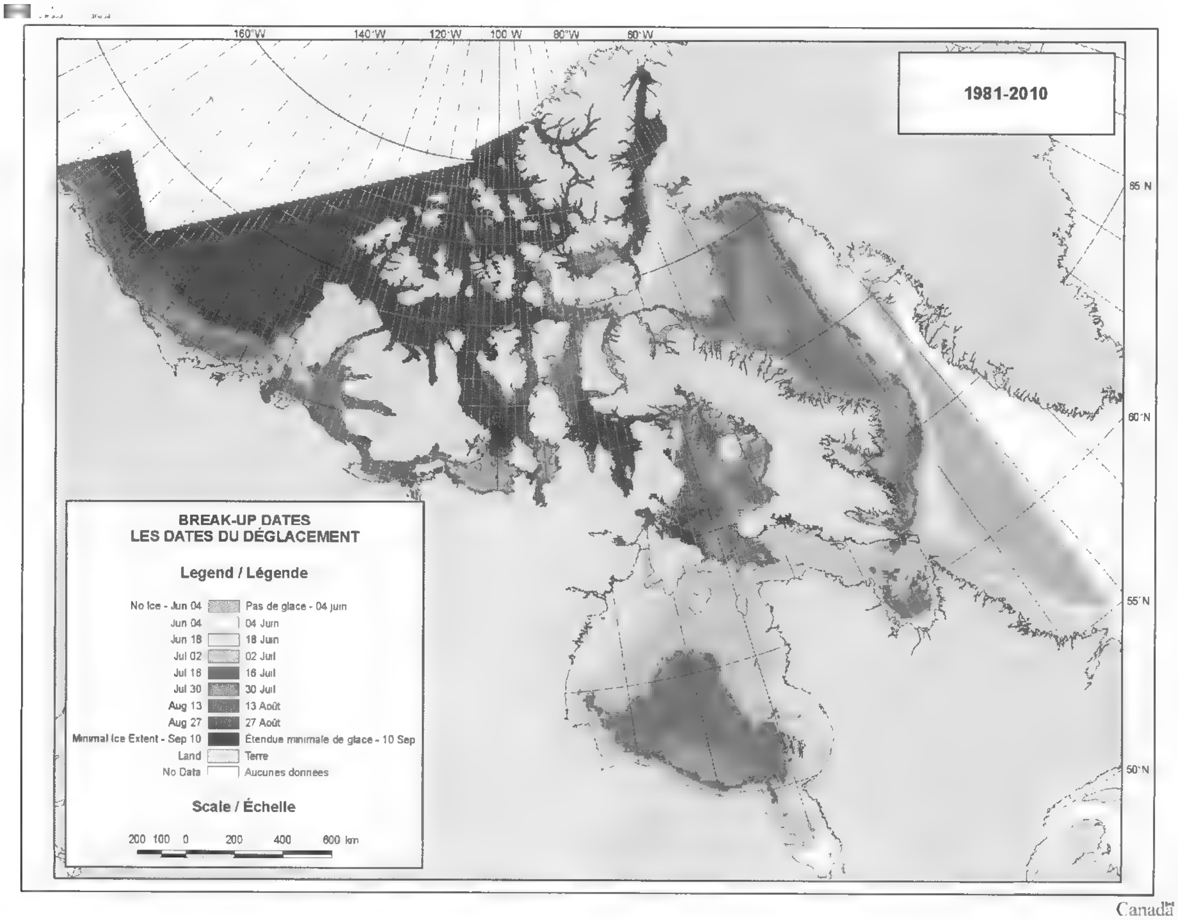


Figure 2 – Ice break up dates in SAR Area 259

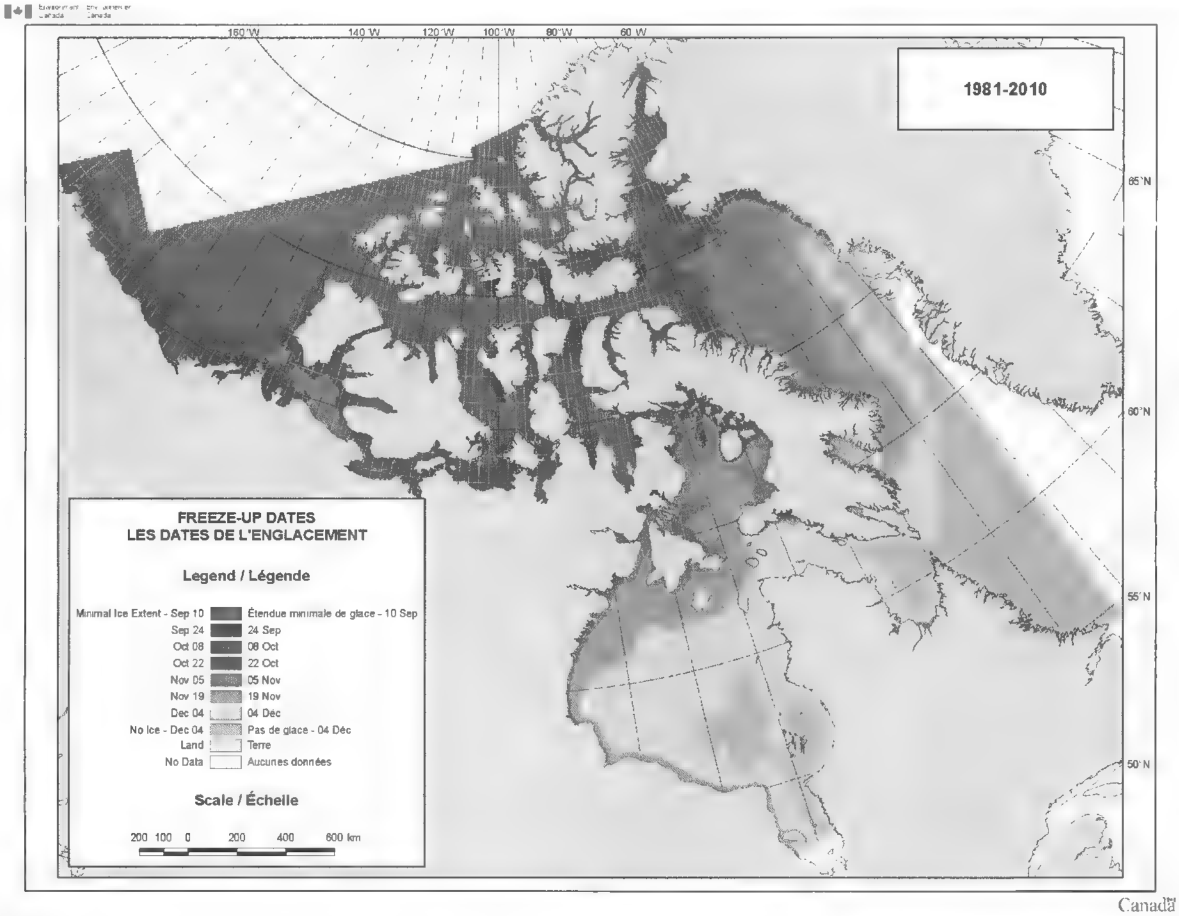


Figure 14 – Winter returns early in area 259 with most areas frozen by October 22.

2.4.1 Beaufort Sea

Old or multi-year ice up to 450 cm thick - the Arctic Pack - continuously circulates with currents and winds in the Arctic Ocean, and it is present year round. Its degree of penetration into the Beaufort Sea at any given time is dependent on the wind regime of the year. On average, the boundary of the Arctic Pack lies from near Cape Prince Alfred south-westward to some 200 km north of Herschel Island and then westward some 200 km off the Alaska North Coast. Between the Arctic Pack and the coastal shore-fast ice, mobile first year ice is predominant through the winter.

The edge of consolidation in Amundsen Gulf can be quite different from year to year, but commonly it lies near Cape Baring or Cape Lambton, or less frequently at Cape Kellett. In spring, northwest winds die off, and east and southeast winds become predominant, so that a polynya develops there. In June, melt begins in the Mackenzie Delta and an open water area also develops quickly. Typically, Amundsen Gulf fractures in late June and the ice drifts out and decays. The fast ice along the Tuktoyaktuk Peninsula fractures in late June or early July, and by the end July an open water route usually develops from Mackenzie Bay to Cape Bathurst. Amundsen Gulf usually clears before August.

West of the Mackenzie Delta to Point Barrow, a narrow shore or flaw lead develops in July. Open drift ice conditions do not develop along the coast until the first week of August and an open water route not until the first week of September.

Freeze-up in the Beaufort depends to a very great extent upon the location of the southern limit of the Arctic Pack. New ice formation starts among the multi-year floes in late September and spreads southward while it also spreads seaward from the coast. By late October much of the ice is at the first-year stage right out to the Arctic Pack. Shore-fast ice is extensive and grows seaward to the vicinity of the 20 metre water depth. Onshore winds during the winter months hold the mobile pack ice tight to shore-fast ice.

During a cold summer, the shore-fast ice along the Tuktoyaktuk peninsula may not completely break until mid-July. These cold summers occur when north westerly winds keep the Arctic Pack close to shore. Open water along the Alaskan coast can develop as early as the third week of July.

2.5 Tide & Current

Currents are light throughout SAR Area 259 with a predominant Westerly flow. Tides throughout the region are 1.0 meter or less.

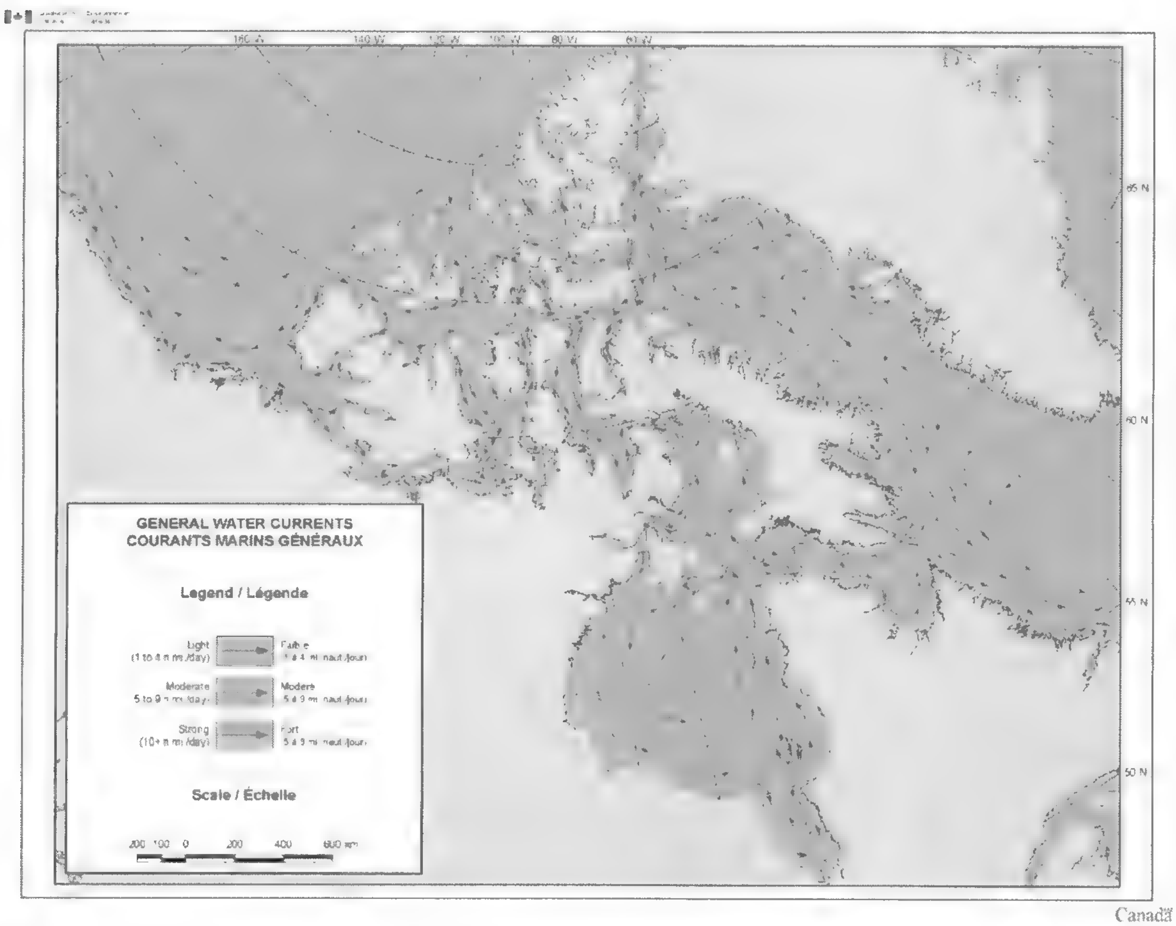


Figure 15 – Light currents circulate in SAR Area 259.

2.6 Effects of Climate Change

2.6.1 Natural Resource Extraction

The Beaufort Sea has been identified as a resource-rich area for petroleum and natural gas products. Oil and gas exploration voyages are expected to reach further north with receding ice boundaries. These voyages are conducted in isolation, often far from shipping corridors.

Increased economic activity in the Beaufort Sea would bring growth to Inuvik and Tuktoyaktuk in the form of commercial infrastructure, housing, and heightened marine activity. Both communities are currently host to oil & gas sector employees.

Current oil field seismic analysis and exploratory drilling occur in the relatively shallow, 80m depth oceanic shelf north of the Mackenzie River delta. The shelf itself extends about 60nm offshore. Similar exploration is occurring in Alaska, where the 30nm US shelf is being tapped for resources with exploration permits already reaching into the 3500m deep section of the Beaufort Sea. Environmental policy and protection in one country will undoubtedly affect the other should an environmental disaster occur.

Figure 16 – Offshore oil and gas in SAR Area 259

2.6.2 Population

In general, a longer ice-free season for arctic communities equates to more opportunity for merchant sealifts, mineral shipment, fishing (commercial and subsistence), cruise ship activity, research vessels, and merchant tankers to service communities and businesses. This gives rise for new jobs and subsequently new residents to arctic communities. In addition, Canadian Inuit currently have a high birth rate, with

family size growing quickly in many communities. Such activity will increase demand on the SAR resources operated by the Canadian Coast Guard in area 259.

2.6.3 Precipitation

Climate change provokes precipitation to reach new extremes of drought and flooding. The volume of water output by the Mackenzie River has potential to drastically affect the ice-free date for communities along the river. Aklavik, a community 1.0 meter above sea level, could see worsening flood and muddy conditions during spring flooding.

2.7 Description, Interpretation & Analysis

2.7.1 Ice Floes

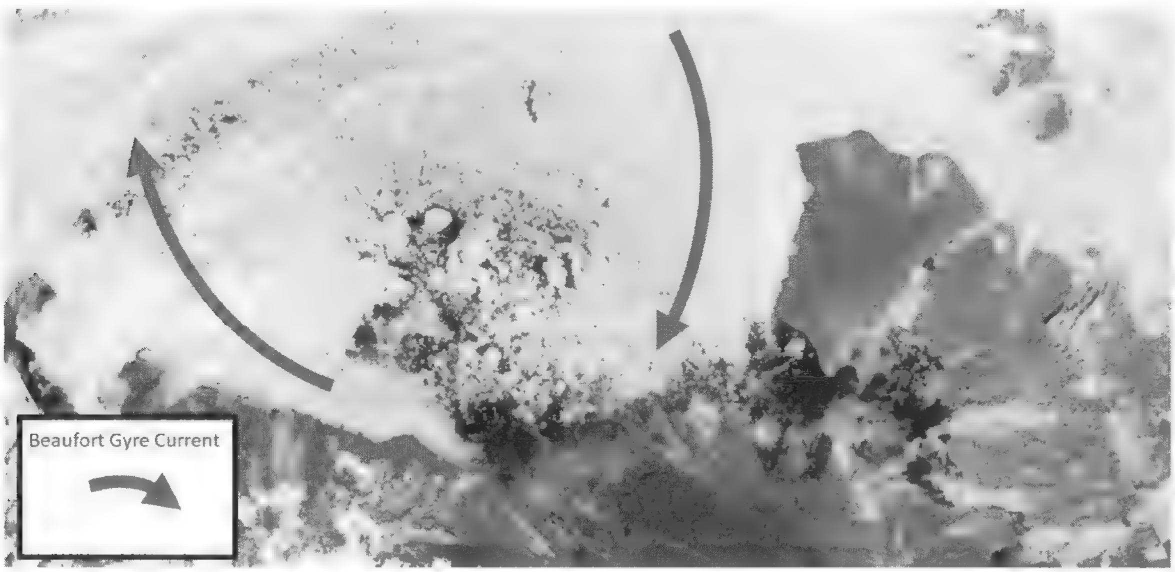


Figure 3 – Ice conditions in July

The Beaufort Sea Gyre is a gentle clockwise current which rotates in Canada Basin. Multiyear Arctic ice pack circulates in this current and behaves in erratic ways.

The shore of mainland Canada consistently experiences melting and ice breakup in a south to north direction as the summer progresses. This occurs approximately along the boundary of the Beaufort Sea shelf, an 80m deep bank before the Arctic Ocean plunges to 4000m depths.

Ice beyond the shelf limits behave differently as it is linked to wind direction and the characteristics of the Beaufort Sea Gyre. In addition; unlike the Eastern Canadian Arctic where the strong Labrador Current draws ice floes out of the Arctic and into warmer waters, the Beaufort gyre simply recirculates the same multi-year ice. As a result, the sea ice conditions in the Amundsen Gulf and to the west of Banks Island are extremely variable year-to-year. In one example, a large ice floe obstructed the west entrance of the Amundsen Gulf – effectively blocking all marine traffic.

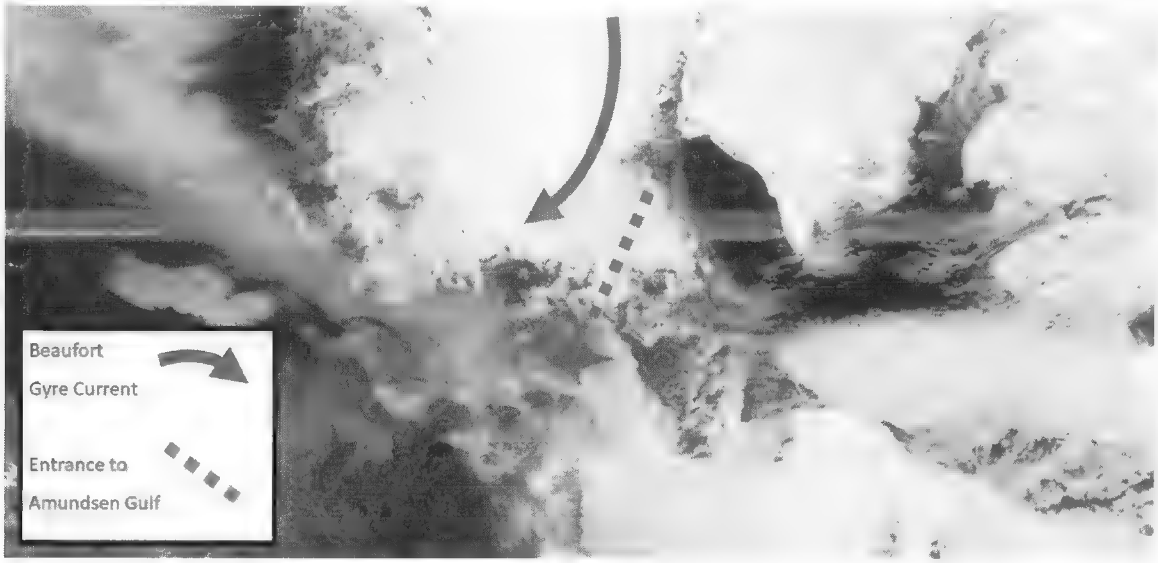


Figure 18 – September 15, 2018. Ice obstructs passage in Amundsen Gulf.

3. Maritime Geography

3.1 Coastal Features

SAR Area 259 is made up of the Beaufort Sea, Amundsen Gulf, and Parry Channel. At present, less than 10% of Arctic waters are surveyed to modern standards.[3]

3.1.1 Mackenzie River Delta

The Mackenzie River links Great Slave Lake to the Beaufort Sea. The river's peak discharge occurs in June, but its flow is generally uniform because of the flat topography east of the river and the many large lakes in the system. The break-up of ice begins at the Liard River in late April, early May. The river is free of ice by early June and stays open until November.

The Mackenzie Delta is a vast fan of low-lying alluvial islands. The delta is 80 km across, bordered by the Richardson Mountains in the west and the Caribou Hills in the east. Below Point Separation the river splits into three main, navigable channels: East Channel, which flows past Inuvik on the easterly edge of the delta; Peel Channel in the west, which flows past Aklavik; and Middle Channel, which carries the main outflow into the Beaufort Sea.

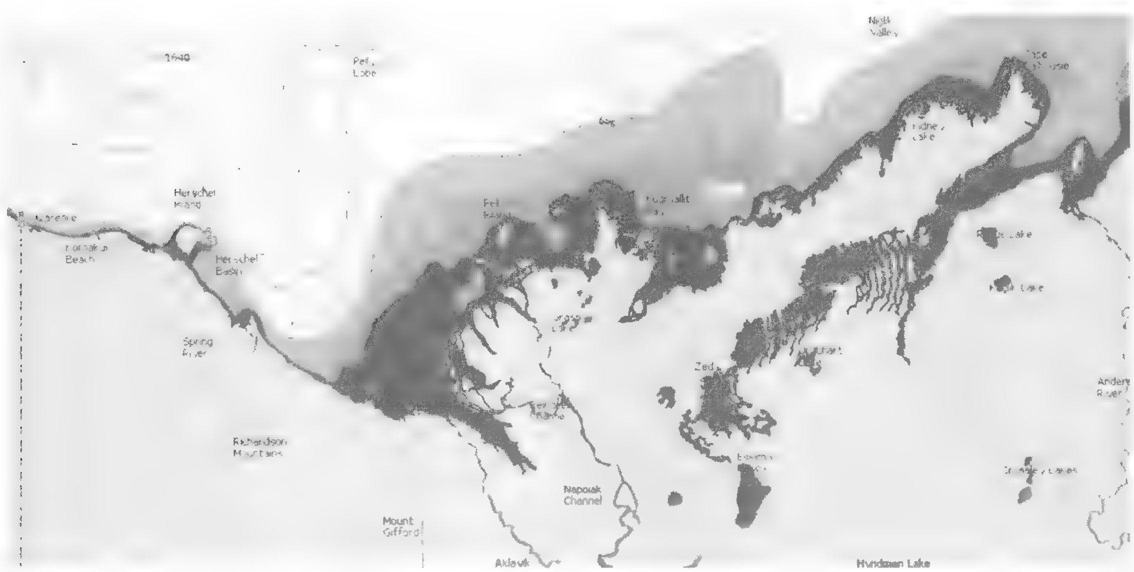


Figure 19 – Navionics chart data for the Mackenzie River

[3] As reported by the Canadian Hydrographic Service.

3.1.2 Amundsen Gulf

Victoria and Banks Islands are the most populous islands of SAR Area 259 and among the largest in Canada. Victoria Island has two well-defined inlets, Minto Inlet to the North, and Prince Albert Sound to the South. Both inlets run approximately west to east. Between them, the Diamond Jenness Peninsula range extends topography 500m above sea level and is often the source of local wind channelling down each inlet. The range frequently re-directs prevailing winds into an east or westerly flow pattern. Shoreline is a mix of mud and rocky tidal flats.

Banks Island's southeast coast is marked by prominent cliffs, giving rise to katabatic wind conditions. The low west coast is characterized by long, sandy offshore bars, rising at the southwest tip to the Nelson Head cliffs (425 m). Limestone cliffs rise at Cape McClure and Cape Crozier on the north coast. Along the east coast the land slopes up from the beach into mud, sand and gravel cliffs.

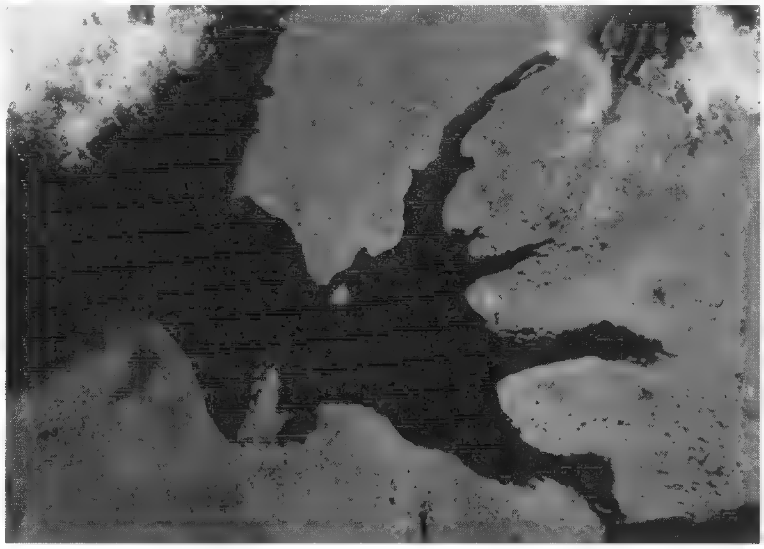


Figure 20 – Amundsen Gulf in September 2010 experience a rare day of clear skies.

Figure 21 – Navionics chart for the Amundsen Gulf.

3.1.3 Parry Channel

Parry Channel is a sea passage running east to west through the arctic islands. Named for explorer W.E. Parry, it begins at Lancaster Sound, passes through Barrow Strait, leads into Viscount Melville Sound, finally reaching the Beaufort Sea through McClure Strait. The permanent pack ice in McClure Strait is an impassable obstacle to further navigation through the Parry Channel, forcing ships making the Northwest Passage to detour far to the south.

The Parry Channel is icebound most years. When it is not, it provides expedited Northwest Passage transiting along windward shores. The narrower Prince of Wales Strait which lies between Banks and Victoria Island is icebound until early September most seasons. The Prince of Wales Straight has been successfully transited, however the route is less popular compared to using the Dolphin and Union strait to the south of Victoria Island where ice conditions are often more favourable.

Figure 22 – The Parry Channel connects the Beaufort Sea to Davis Straight. The portion above Banks Island is the McClure Straight.

3.2 Oceanographic Features

SAR Area 259 contains the Beaufort Sea where it meets the Canadian Arctic Archipelago and Amundsen Gulf. 450cm thick Arctic pack ice circulates year-round in the Beaufort Sea. The archipelago is relatively shallow. The water is typical of Arctic Ocean water, low in temperature and salinity. Tides are mainly semidiurnal, ranging from 0.3 to 0.5 m.[4]

The Beaufort Sea can be taken to include the whole of the clockwise gyre of the Canada Basin of the Arctic Ocean north of Alaska, Yukon and the Mackenzie Delta coast, bounded on the east by Banks Island and Prince Patrick Island. Alternatively, it has been defined as that part of the Arctic Ocean lying south and east of a line connecting Point Barrow, Alaska, and Lands End, Prince Patrick Island.

The Beaufort Sea coast is low lying and subject to considerable scouring by ice and erosion by storm surges. The Canadian shelf and the Yukon/Alaskan shelf form the southern boundary of the Beaufort Sea, but they have significantly different widths and alignments. The Canadian shelf is approximately 110 km wide and runs northeast. A major submarine canyon, Mackenzie Trough, cuts the shelf east of Herschel Island. From the edge of the shelf (depth approximately 80 m) the bottom deepens fairly rapidly to 4000m in Canada Basin.

Figure 23 – ARCGIS rendering of Arctic Ocean bathymetry.

[4] www.tides.gc.ca

4. Demographics

The regional population of Sachs Harbour, Ulukhaktok, Paulatuk, Tuktoyaktuk, Inuvik, and Aklavik is 5495 (2016 census).

Figure 24 – Map showing Sachs Harbour, Ulukhaktok, Paulatuk, Tuktoyaktuk, Inuvik, and Aklavik

4.1 Coastal Population Centres

Between the 2011 and 2016 census, the population of several northern hamlets and towns decreased at rates from -1.5% in Ulukhaktok, to -15.3% in Paulatuk. Tuktoyaktuk was an exception, which grew by 5.2% during the same period of time. The most commonly spoken languages are English and Inuvialuktun (Western Arctic dialect of Inuktitut).

4.1.1 Aklavik

Table 5 – Aklavik Details

Population	590
Location	Latitude: 68° 13' 8.9" (68.2191°) north Longitude: 135° 0' 38.6" (135.0107°) west Elevation: 1 meter (3 feet)
Description	Aklavik, a fishing and trapping community of some 600 Gwich'in and Inuvialuit, is located on the Peel channel of the Mackenzie River Delta 113km south of the Arctic Coast. Road access is limited to the ice road across the Mackenzie Delta to Inuvik. In summer, Aklavik receives supplies via tug boat from Inuvik.

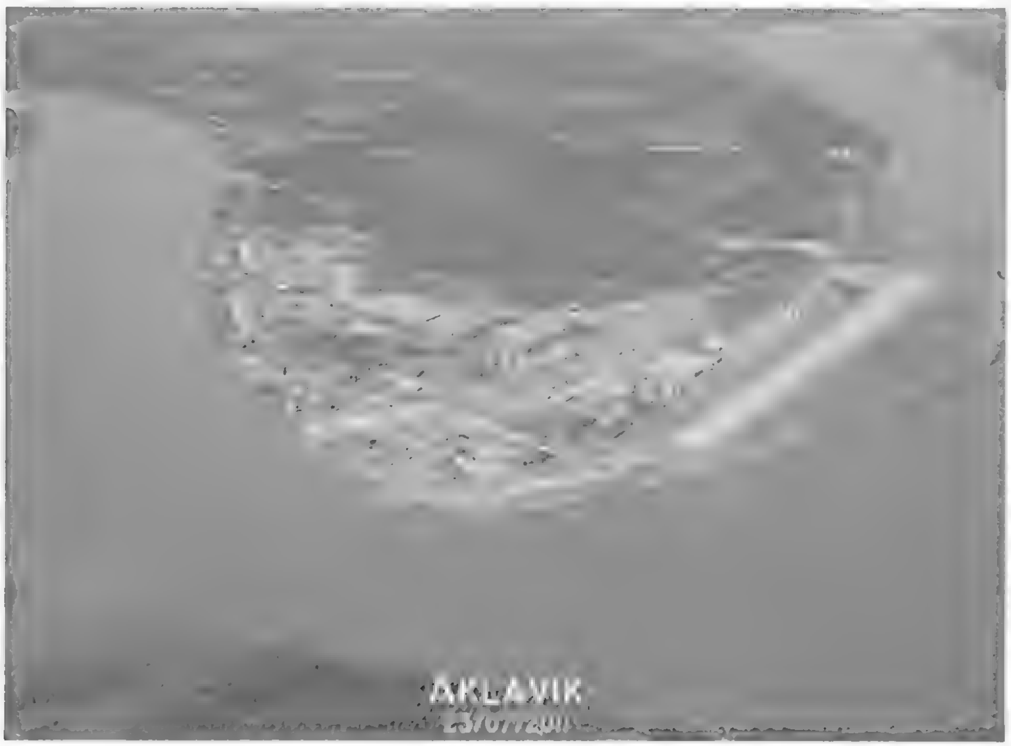


Figure 25 – Aklavik is near the confluence of the Mackenzie River.

4.1.2 Ulukhaktok

Table 6 – Aklavik Details

Population	396
Location	Latitude: 70° 44' 11" (70.7364°) north Longitude: 117° 46' 17.6" (117.7716°) west Elevation: 23 meters (75 feet)
Description	Situated on the west coast of Victoria Island. Ulukhaktok, formerly 'Holman' is one of two settlements on the island. Visited by 2 cruise ships per year. Supplied by tug boats routed via Sachs Harbour. The community has a small airfield which operates flights to Inuvik.

Figure 26 – Aerial view of Ulukhaktok

4.1.3 Inuvik

Table 7 – Inuvik Details

Population	3,243
Location	Latitude: 68° 20' 59.5" (68.3499°) north Longitude: 133° 43' 18.5" (133.7218°) west Elevation: 15 meters (49 feet)
Description	Major maritime hub. Inuvik is the largest community in the Arctic region of SAR Area 259. Frequent tug vessels departing to Tuktoyaktuk and Aklavik. Fields tug vessels from further upriver. Canadian Coast Guard tenders & RCMP vessels frequently stop over here. Inuvik is situated on the East Channel of the Mackenzie Delta. The Arctic Ocean is 97 kilometres north. Some residents earn their living hunting, trapping and fishing, but most are employed in government and aboriginal offices or in transportation, construction, petroleum exploration and tourism companies.

Figure 27 – Aerial view of Inuvik

4.1.4 Paulatuk

Table 8 – Paulatuk Details

Population	265
Location	Latitude: 69° 21' 3.5" (69.351°) north Longitude: 124° 4' 7.9" (124.0689°) west Elevation: 1 meter (3 feet)
Description	Situated on the south shore of the Amundsen Gulf, Paulatuk is a small, traditional Inuvialuit community with deep roots in hunting, trapping and Arctic-char fishing. It's also a basecamp for trips to Tuktut Nogait National Park, the Cape Parry Bird Sanctuary, and the Smoking Hills. Access is by air from Inuvik. Visited by one cruise ship in 2013. Tug boats make up the rest of commercial boating activity, arriving from Tuktoyaktuk and Ulukhaktok. Storm surges up to 0.5m are common in the summer months as prevailing winds push the sea ashore.

Figure 28 – Paulatuk is located on the southern shore of the Amundsen Gulf.

4.1.5 Sachs Harbour

Table 9 – Sachs Harbour Details

Population	103
Location	Latitude: 71° 59' 5.8" (71.985°) north Longitude: 125° 14' 47.9" (125.2467°) west Elevation: 46 meters (151 feet) Sachs Harbour is located on the southwest shore of Banks island. The community is exposed to the Beaufort sea with long sandbars along shore.
Description	Banks island is home to more than half the world's muskoxen, plus Aulavik National Park, the epic Thomsen River, bird sanctuaries, and the famed HMS Investigator shipwreck. Served by tug boats from Tuktoyaktuk, Sachs harbour was notably visited by 130m LOA cruise ship KAPITAN KHLEBNIKOV in 2016.

Figure 29 – Sachs Harbour is the northernmost community on Northwest Territories.

4.1.6 Tuktoyaktuk

Table 10 – Tuktoyaktuk Details

Population	898
Location	Latitude: 69° 26' 41" (69.4447°) north Longitude: 133° 2' 3.2" (133.0342°) west Elevation: 1 meter (3 feet)
Description	Tuktoyaktuk, known simply as 'Tuk', is situated on the Arctic Ocean. Over the years it has served as a base for Inuvialuit caribou and beluga hunting, a DEW Line radar site, and a centre of oil and gas exploration. The Inuvik–Tuktoyaktuk Highway, a 138km gravel road, connects Tuktoyaktuk to Inuvik. This is the only community to experience a growth in population since 2011 which coincided with the recently completed road access along with Tuk becoming a second shipping hub to Inuvik, serving communities in the Amundsen Gulf.

Figure 30 – Tuktoyaktuk has been experiencing growth in the last decade as a result of new highway access and the oil & gas industry.

4.1.7 Hay River

Table 11 – Hay River Details

Population	3528
Location	Latitude: 60° 48' 56" (60.8156°) north Longitude: 115° 47' 59.7" (115.7999°) west Elevation: 152 meters (499 feet)
Description	The town of Hay River is in Northwest Territories in northern Canada. A drivable northern destination for ice fishing and sport fishing. Hay River is a small town on the shore of Great Slave Lake in the Northwest Territories on Canada.

Figure 31 – Hay River waterfront

4.1.8 Yellowknife

Table 12 – Yellowknife Details

Population	19569
Location	Latitude: 62° 27' 14.8" (62.4541°) north Longitude: 114° 22' 20.9" (114.3725°) west Elevation: 252 meters (827 feet)
Description	Situated on the Northern shore of Great Slave Lake, Yellowknife is the capital of the Northwest Territories, Canada. Founded in 1934, the city is located in the traditional territory of the Yellowknives Dene First Nation who founded the nearby community of Dettah in the early 1930s. Yellowknife has a nearby community of houseboats on Great Slave Lake.

Figure 32 – Houseboats in Yellowknife, NWT

4.1.9 Norman Wells

Table 13 – Yellowknife Details

Population	778
Location	Latitude: 65° 16' 55.2" (65.282°) north Longitude: 126° 49' 58.4" (126.8329°) west Elevation: 17 meters (56 feet)
Description	Tucked between alpine foothills and the big Mackenzie River, this is a historic oil town – explorer Alexander Mackenzie reported oil seeping from the riverbanks in 1789, and today pump jacks and storage tanks abound. Access is by air and, in winter, by winter road from Wrigley.

Figure 33 – Norman Wells

4.2 Deep Water Ports

There are no deep water ports in SAR Area 259.

4.3 Review of Maritime and Economic Activities

SAR Area 259 is unique from the eastern and northern arctic due to its road access. Tug boats are used to move barges of supplies to and from communities. Inuvik and Tuktoyaktuk are the main commercial shipping hubs, where supplies driven north are loaded for transportation to the 3 remote communities in the Amundsen Gulf area and Aklavik – located in the Mackenzie River delta. Tug boats travelling further upstream (south) on the Mackenzie River are bound for communities outside of Inuvialuit nunangat.

Fishing recreationally and for subsistence is widespread in the area. Most small craft are made of metal, with open hull construction. Beaching vessels is a common method of storage, as such nearly all small craft are small enough to be physically pulled up a beach and pushed off of one.

Figure 4 - Small craft are seen beached in Ulukhaktok (Peter McNally).

Pleasure craft transiting the northwest passages are rare. Examples exist and such passage making is increasing in popularity. NORDREG reported 3 vessels in 2016, 3 in 2015, 4 in 2014, 7 in 2013, and 10 in 2012. This does not capture vessels which are not required to report to NORDREG due to their size or local transits between communities using small craft. Inuit reported 5-7 pleasure craft sailboats per year.[5]

Figure 35 – A ketch rigged yacht anchored in Tuktoyaktuk (Francis Anderson)

[5] Arctic Bay, during 2019 RAMSARD community engagement

Commercial passenger vessels regularly frequent the area but take interest in only a few features of the region before moving on.[6] Oil & gas exploration and extraction licenses exist north of the Mackenzie River, where commercial survey vessels work in isolation.

SRA 259 Commercial Vessel Port Visits

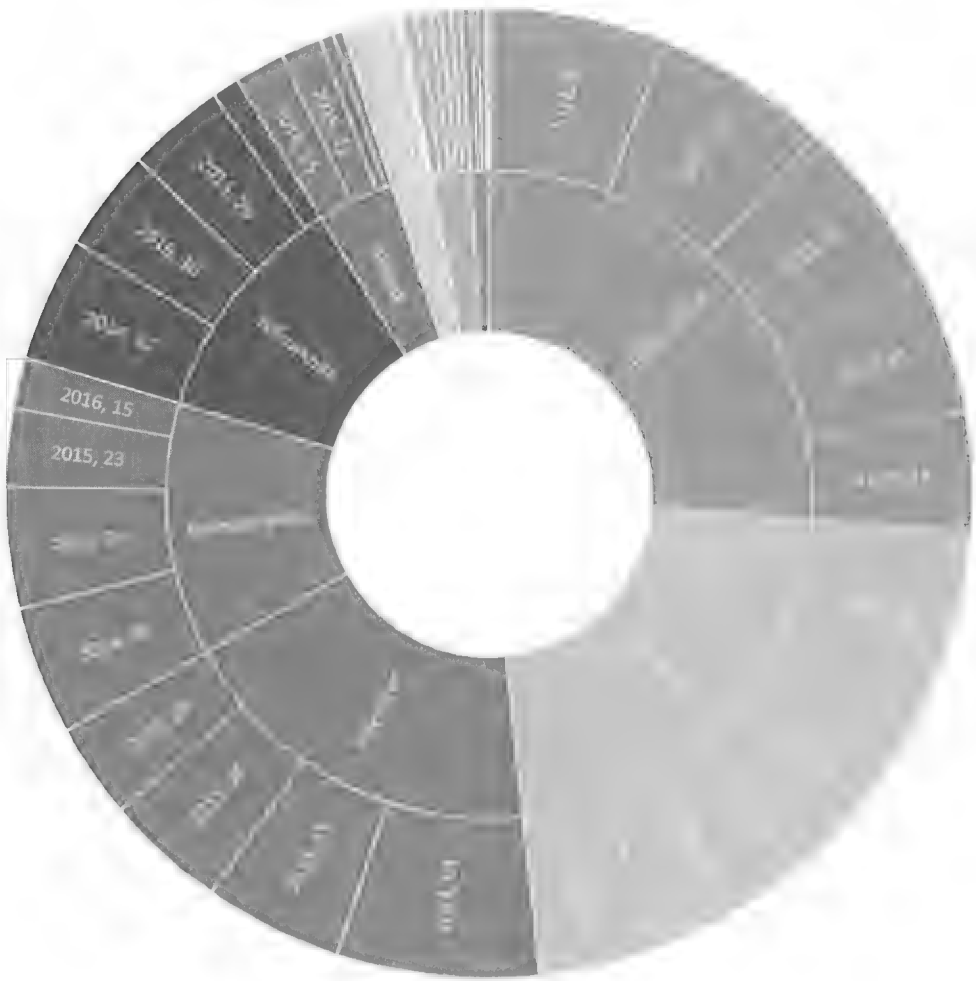


Figure 36 – Five year average vessel traffic in Area 259.

This pie chart depicts communities, year, and number of port visits. INNAV data does not exist for several communities during 2012. Inuvik and Tuktoyaktuk, the only two Inuit communities served by roads, are marine hubs for an active fleet of tug boats which deliver goods to remote communities in the Amundsen Gulf. INNAV data reported a significant amount of tug vessels which depart and arrive at the same community, days apart, without reporting stopping over elsewhere. This anomaly is attributed to insufficient position reporting from vessels.

[6] Revealed through study of MCTS INNAV data call-in locations.

4.3.1 Ferry Operations

According to Aklavik.ca; "Many local boats are not publicly listed but will make frequent daily trips on the river." Charter boat services exist for travel between Aklavik and Inuvik through the Aklavik Community Corp, Aklavik Indian Band, and Up North Tours (based out of Inuvik).

The remainder of Inuit communities are only accessible by air (via Inuvik) or ice road. Ferries cross the Mackenzie River in six different locations.

4.3.2 Commercial Fishing

There are no commercial fishing vessels which operate in the Beaufort Sea. The last Trawler to make a call at a NWT port was F/V Frosti, in 2014. There are 3 small craft harbours on Great Slave Lake which operate commercial fishing fleets. These vessels are not large enough to require NORDREG check-ins.

4.3.3 Recreational Fishing & Boating

Many people in the region fish. Due to Inuit traditions, food insecurity, and high unemployment; fishing is rarely done recreationally by locals. Guides and outfitting companies exist in every community which offer fishing trips to visitors and tourists. The government of NWT sells fishing licenses for a fee.

The Inuvik Qayaq (kayak) club has approximately 400 members.[7] Qayaq practice sessions are offered twice per week and include safety training. Membership cost $50 in 2018. From the organization's website, *"The Inuvik Qayaq Club was established to foster and promote traditional qayaqing skills in Inuvik, the communities of the Inuvialuit Settlement Region and the Beaufort Delta."*

Figure 37 – Inuvik Qayaq Club

4.3.4 First Nations Maritime Activities

Inuvialuit people in SAR Area 259 maintain a close relationship with the geography in which they live. "Harvesting" is the general term used to describe the act of hunting, trapping, gathering, and fishing in Northern communities. Harvesting activities are very popular in Ulukhaktok, Sachs Harbour, Aklavik, and Paulatuk – in part due to their remoteness.

Most non-commercial vessels used for recreation and subsistence fishing are 26' LOA or less.[8] Overleaf is an example of a small craft operating on the Mackenzie River near Inuvik.

[7] On social media.
[8] As reported by Small Craft Harbours Canada and during 2019 RAMSARD community engagement

Figure 38 – A small craft on plane in the Peel channel.

4.3.5 Eco-tourism Operations

All communities operate one or more outfitters which typically offer professional guides, vessels, snowmobiles, clothing, hunting, fishing, and camping equipment. Attractions include; Aulavik National Park on Banks Island, Banks Island Migratory Bird Sanctuary, Kendall Island Bird Sanctuary, and Tuktut Nogait National Park.

Popular marine activities include:

- Whale watching
- Seal and seabird wildlife tours
- Fishing
- Iceberg viewing
- Guided expeditions to whaling camps
- Scenic boat trips between communities

Figure 39 - Tundra North Tours, a guiding company from Inuvik, offers 5-day boat trips to Herschel Island, 150nm away.

4.3.6 Commercial Cargo Operations

INNAV data was compiled for vessels operating in the NORDREG zone from 2012 – 2016. Any vessel which made 3 or more port visits in NORDREG during this time have been included in this list. A search was run for each vessel via the Transportation Safety Board of Canada (TSBC) database from 1991 – 2019. Wherever a vessel has been involved in a TSBC marine investigation, a brief summary is provided.

The following vessels are known to conduct tug operations in NORDREG.

Table 14 – Vessels conducting tug operations in NORDREG

Tug Vessel:	LOA (m)	Transportation Safety Board of Canada Remarks
Alex Gordon	63	No marine investigation reports exist for this cohort of vessels from 1991 – 2019.
Bert Long	21	
Bob's Welding 1	14	
Edgar Kotokak	47	
Fathom Wave	19	
Henry Christoffersen	47	
Island Tugger	36	
Jim Kilabuk	63	
Kelly Ovayuak	45	
Nunakput	52	
Pisurayak Kootook	49	
Risco Reegan	20	
Vic Ingraham	47	
W.H. Horton	18	

The following list of merchant vessels are known to regularly transit though NORDREG.[9]

Table 15 – Merchant vessels transiting regularly through NORDREG

Merchant Tankers:	LOA (m)	Transportation Safety Board of Canada Remarks
Alsterstern	161	No investigations
Dara Desgagnes	124	No investigations
Espada Desgagnes	228	No investigations
Havelstern	161	No investigations
Jana Desgagnes	123	No investigations
Maria Desgagnes	120	On 12 September 2005, Maria Desgagnes collided with Sailing vessel El Tio in the St. Lawrence River.
Nanny	116	Ran aground October 25 2012 while outbound from Baker Lake, NU damaging forward section of hull. Refloated Oct 27 and

[9] Vessels which made 3 or more trips in NORDREG from 2012-2016

		proceeded to St. John's, NFLD for repairs. No injuries or pollution reported. Nanny ran aground a second time on Oct 14, 2014 near Chesterfield Inlet.
Sarah Desgagnes	147	No investigations
Travestern	161	No investigations
Uvaq	164	No investigations
Ugale	195	No investigations
Merchant General:		
Anna	173	On 29 Aug 2017; Vessel lost power and subsequently ran aground near Beauharnois, Quebec.
Avataq	113	No investigations
Claude A Desgagnes	138	On 6 Nov 2013, struck the approach wall of Iroquois Lock in St. Lawrence Seaway. Subsequently, the vessel ran aground. No pollution or injuries reported, the ship sustained minor damage.
Mitiq	136	No investigations
Qamutik	136	No investigations
Rosaire A. Desgagnes	138	No investigations
Sedna Desgagnes	139	No investigations
Umiavut	113	No investigations
Zelada Desgagnes	138	No investigations

4.3.7 Cruise Ship Operations

Table 16 – Cruise Ship Operations

Merchant Passenger	LOA (m)	Transportation Safety Board of Canada Remarks
Akademik Ioffe	117	2018 grounding under investigation.
Bremen	111	No investigations
Crystal Serenity	250	No investigations
Hanse Explorer	47	No investigations
Hanseatic	123	On 29 August 1996, ran aground in Simpson Straight, NWT.
KAPITAN KHLEBNIKOV	129	No investigations
L'Austral	142	No investigations
Le Boreal	142	No investigations
Le Soleal	142	No investigations
NatGeo Explorer	112	No investigations
Ocean Endeavour	137	No investigations
Sea Adventurer	100	No investigations
Sea Explorer I	90	No investigations
Silver Explorer	108	No investigations
The World	196	No investigations

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Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

2018-19 Maritime Search and Rescue Arctic Analysis (Area 010)

Canada

Record of Amendments

#	Date	Description	Initials

Approvals

JEAN-SÉBASTIEN LANDRY AND JAMES HARE REGIONAL RAMSARD ANALYST	Recommended : JSL JH Date: 18/03/2019
STEVE THOMPSON DEPUTY SUPERINTENDENT, ARCTIC OPERATIONS	Approved : Date: 18-Mar-2018
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1. Recommendations Table for SAR Area 010

#	RISK	MITIGATION RECOMMENDATIONS
SAR Area 010		
1.	**LACK OF SECONDARY SAR IN ACTIVE COMMUNITIES** **Cape Dorset (n=7), Pangnirtung (n=6), Iqaluit (n=5)** and **Qikiqtarjuaq (n=4)** are respectively the most active Arctic communities in SAR Area 010. In SAR Area 010, from 2012 to 2016, local CCGA had a role in 3% of incident resolution	• Focus the implementation of CCGA in these communities
2.	**HIGH POTENTIAL OF SMALL CRAFT TRAFFIC BETWEEN COMMUNITIES DURING THE SUMMER** • Small craft regularly transit 300-400 nm between communities along exposed shorelines	• Continue the implementation of CCGA units in Arctic communities through the OPP's CCGA Expansion and Community Boat initiatives • Increase the presence of CCG SAR training officers in the Arctic • Increase the safety culture by leveraging CCGA presence via regional Boating Safety MOU with Transport Canada

3.	**LIMITED BOATING SAFETY / SAR INCIDENT MANAGEMENT STRATEGY IN THE ARCTIC** • Poor survival time of mariners in distress due to cold water • Elders and CCGA personnel reported young people are being irresponsible while boating – taking on higher risk, departing in poorer weather • Limited charts available in local communities for SAR planning & **SAR INCIDENTS INVOLVING FISHING VESSELS** Commercial fishing fleets in Davis Strait are exposed to powerful storms throughout the boating season, especially autumn 45 ft. waves have been reported in Davis Strait from Qikiqtarjuaq community members Area 010 is the only area with incidents involving fishing vessels (total of 15 x M1 to M3)	• Carry out SAR interoperability exercises with CCG, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly territorial governments • Sign regional MOU with Transport Canada to increase boating safety culture by leveraging CCGA • Recruit young people into CCGA, provide communities/hamlet offices an outlet to receive updates from JRCC during incidents • Fund Canadian Safe Boating Council campaigns such as Operation Life Preserver. Provide boater education on the effects of cold water, HELP position, and distribute life jackets and floater suits • Recommend expansion of the mandate of Canadian Safe Boating Council's Operation Life Preserver to include floater suits for northern mariners. • Distribute buoyancy tanks for installation in small craft so they do not sink when swamped/ capsized. • Chart to modern standards all small-craft navigable waters within 75 nautical miles of populated areas • MOU agreement between the Coast Guard and the Canadian Hydrographic Survey Resource for Arctic SAR Team to use charts as engagement gifts. They are more cost-effective than most options and far more sought-after by communities

4.	**HIGH RISK GROUNDING FROM PASSENGER VESSELS** • For passenger vessels, the most common issues are running aground due to poor navigation or charting. Examples include Clipper Adventurer (197 POB) in 2010, and Akademik Ioffe (162 POB) in 2018. • Russian Charts of the Canadian Arctic are considered more useful than Canadian Hydrographic Service resources • Ice conditions are less severe in the past few years, which opens unexplored areas	• Improve Canadian Hydrographic Survey Resources for Arctic-related charting • Ongoing implementation of the Low Impact Shipping Corridors initiative. • Increase Coast Guard presence in the Arctic in July and August, especially in Foxe Basin and Hudson Bay
5.	**CCG IS NOT ALWAYS NOTIFIED OF MARINE SAR CASES** • Many SAR incidents go unreported in the North • MCTS Iqaluit is not yet adjusted on instant communication for SAR incidents • Confirmation bias exists in SAR reporting: locals will only call government for help if they know the government is nearby • JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.	• Link Iqaluit MCTS services to community towers to offer services. It is recommended that steps be taken to allow MCTS Iqaluit to monitor community VHF towers for offering services such as sail plans, weather, issuing MARB's, and coordinating searches with JRCC. • Provide communities (via Hunters and Trappers Associations / Organizations) with loanable AIS/InReach/SPOT devices to minimize search time • Increase public awareness of JRCC and the SAR system (i.e., who to call, how it works) • During SAR incidents, provide communities / hamlet offices an outlet to receive updates from JRCC

		• Carry out SAR interoperability exercises with Coast Guard, Canadian Forces (CF), CCGA, CASARA, other Federal Government departments and most importantly the territorial government
6.	**JRCC and MCTS – Lack of environmental data**	• Provide the Rescue Coordination Centre with data on ice drifts and characteristics, similar to what's available to the CCG Ice Office.
7.	**JRCC and MCTS – Lack of position finding capability** • VHF in Arctic is not equipped with RDF • No Cellular GPS Positioning Capabilities	• Increase MCTS RDF capabilities • Provide small craft with loanable AIS/InReach/SPOT devices to minimize search time • Provide JRCC general locations of cabins on shore, used by locals in the event of adverse weather conditions
8.	**JRCC and MCTS – Lack of Inuktitut Speaker / Operator** • Large number of Inuktitut only speaking mariners, difficulty for locals to communicate with JRCC and MCTS	• Ensure 1 MCTS member can translate Inuktitut to English • Ensure timely access to Inuktitut interpretation services in interim
9.	**IMPACT OF COMMERCIAL ACTIVITIES ON HARVESTING AREAS** • Hunters travel further away from communities in order to harvest marine wildlife whenever commercial vessels are in the vicinity	• Complete a study commercial vessel transit patterns and restriction possibilities. For example, limit cruise, cargo, ore, and merchant traffic to entering and exiting only one side of Eclipse Sound.

2. Arctic SAR Area 010 Summary

In summary, the Canadian Coast Guard achieved its performance standard in SAR Area 010 four years out of the five under review (2012-2016), not achieving the performance standard in 2012 (66.67%).

Figure 1: Regions of risk identified in SAR Area 010

To reduce the risks of a Search and Rescue incidents occurring in SAR Area 010, the mitigation measures presented at the beginning of this report are strongly recommended.

For that reason, after completing a thorough analysis of Area 010 the analysis team has come to the conclusion that:

A situation exits that requires immediate action

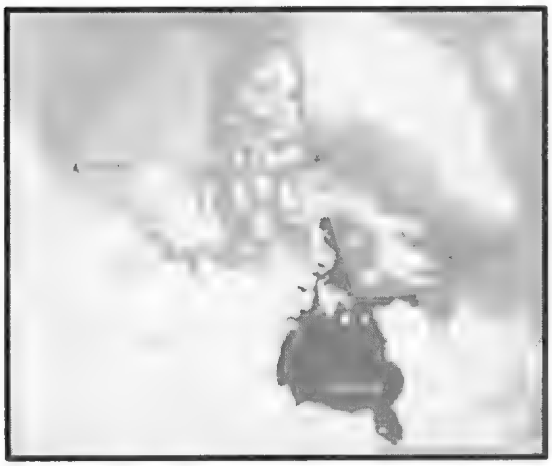
To mitigate the risk of injuries and lives lost due to marine SAR incidents, the recommendations in this report the team has chosen to highlight for further considerations are:

1. The continuation of CCGA implementation in Arctic communities
2. The establishment of a SAR prevention strategy adapted for northern climates
3. The consideration of the establishment of an Inshore Rescue Boat station in Cape Dorset, NU.

If implemented, the analysis team has concluded that the level of risk to the CCG with regards to SAR delivery will be lowered and the CCG Performance Standard Results will improve.

3. Introduction

Due to the limited scope but large area under study – 50 % of the coastline of the country – this study did not have the intention to focus on regionally specific challenges, like specific shipping channel navigational risks, the SAR component of ice-breaking operations, or Arctic Mass-Rescue Scenarios, which are already taken care by Subject Matter Experts (SME). For this reason, we urge the readers of this report to consult experts at the Maritime Communications and Traffic Services Centre in Iqaluit, the Regional Operation Centre in Montreal, the Joint Rescue Coordination Centres in Trenton and Halifax, and Subject Matter Experts on Mass Rescue prior of making decisions affecting their Arctic operations.



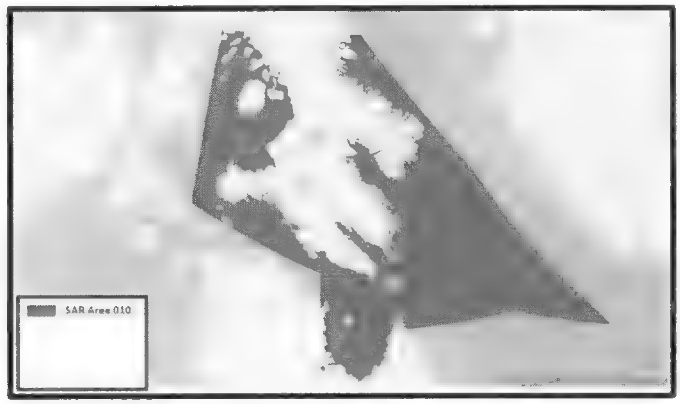


Figure 2 and 3 : Map of SAR Areas under review and Map of SAR Area 010

Areas 259, 260 and 155 are served by Joint Rescue Coordination Centre (JRCC) Trenton for coordination of maritime search and rescue (SAR). Area 010 is served by JRCC Halifax.

This document is a risk-based analysis of maritime SAR delivery in SAR Area 010 using data from 2012-2016. The purpose of this report is to identify the need for Coast Guard SAR assets using historical incident data and SAR partner engagement. Current SAR delivery will be assessed using the Canadian Coast Guard SAR Performance Standard.

SAR Area 010 encompasses the shoreline of Baffin Island south of 70°N. The area does not include rivers and lakes in the interior of Baffin Island. The regional population is approximately 16,000. The most commonly spoken languages are Inuit and English. All details concerning wind, ice, tides, commercial and local maritime activities, and more, can be found in our environmental scan in **Annex A.**

Throughout the report, the analysis team started with an overview of the SAR Area, followed by a review of SAR incident data from the Coast Guard's System of Information on Search and Rescue (SISAR). This is followed by a summary of SAR engagement, and a section on primary SAR vessels and SAR incident response characteristics in relation to the CCG Performance Standard for SAR.

4. Incident Data Review and Analysis

As per the Canadian Aeronautical and Maritime Search and Rescue (CAMSAR) manual, the definitions of the classifications of marine cases are as follows:

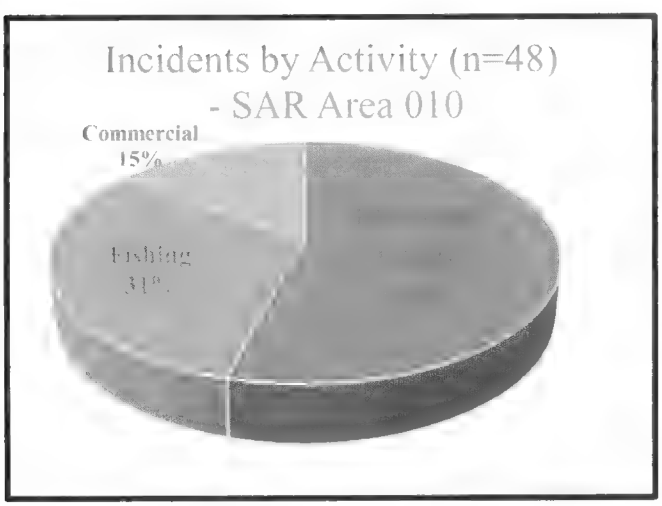
- **M1 - Distress** – A person or persons from a vessel are threatened by grave and imminent danger and require immediate assistance
- **M1P - Distress Reported After the Fact** – An M1 case that has been resolved but would have required a response had the SAR system been alerted at the time of the case.
- **M2 - Potential Distress** – The potential exists for an M1 case if timely action is not taken; i.e., immediate response is required to stabilize a situation in order to prevent distress.
- **M3** - A maritime situation other than an M1 or M2 case, where assistance is rendered to prevent case degradation to greater potential danger.

This step uses the five-year historical SAR incident data from SISAR to ascertain what risks exist in the area under review. This data review and analysis serve as a description of what maritime risks exist in the Arctic. Risk scenarios considered in this step are those that involved consequences of serious injury or loss of life and those which had the potential to develop into scenarios with such consequences (M1, M2).

4.1 . Incidents Analysis – M1 to M3

In Area 010 from 2012 – 2016 there were a few SAR incidents involving commercial vessels (n=7). In fact, Area 010 has SAR incidents mostly for pleasure craft (n=26) and fishing vessel (n=15), with incidents of fishing vessels not found in the three other Arctic SAR areas.

SAR Area 010 becomes busier during the summer months. Each year, 13 offshore fishing vessels return to Davis Strait, most with a crew of approximately 30. In addition, 11 fuel tankers and 8 merchant cargo vessels with an average crew size of 20 begin servicing Area 010 communities in July and continue through until October.



Lastly, up to 10 cruise ships enter the NORDREG area each season with passenger/crew counts ranging from 12 (Hanse Explorer) to 1622 (Crystal Serenity). To support the increased level of tourism in the region, flights to and from Iqaluit spike in August annually.

From 2012 to 2016, Area 010 experienced M1 cases involving pleasure craft (n=5), fishing vessels (n=3) and commercial vessels (n=2), both of which were medical incidents in nature.

Figure 4: SAR Area 010 Incidents by Activity

4.2 Alerting Method from Pleasure Craft

Within SAR Area 010, EMO Nunavut is most often alerted first for M1 to M3 SAR cases, followed by JRCC Halifax.

JRCC Halifax staff have noted that SPOT beacons are starting to become more common. EMO Nunavut noted that SPOT beacons represented in average approximately 25% of their alerts.

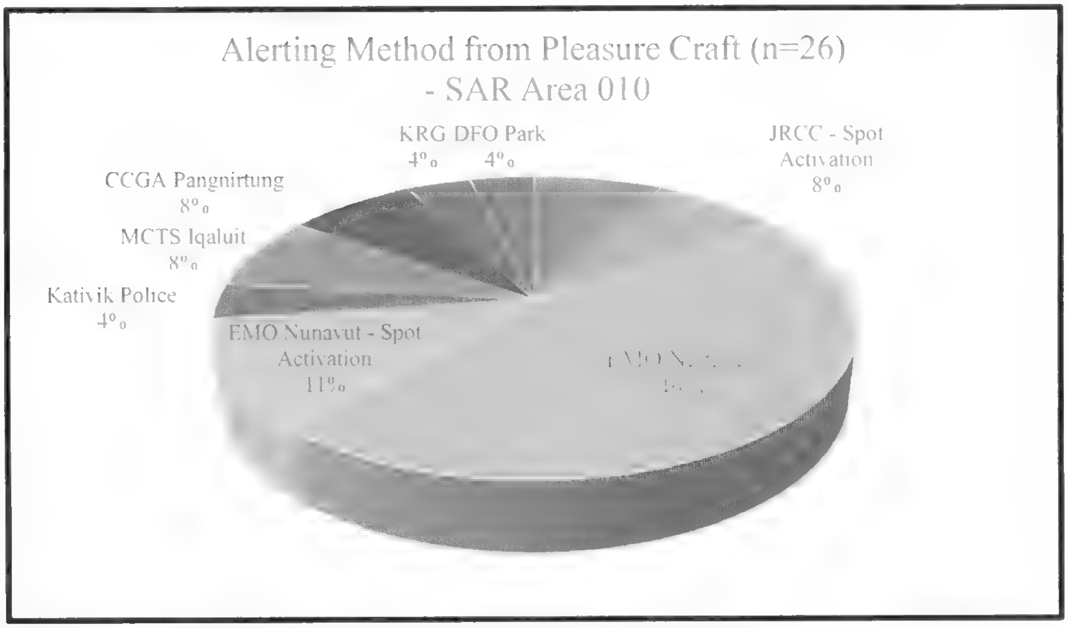


Figure 5: SAR Area 010 Alerting Method from Pleasure Craft

4.3 Alerting Method from Fishing and Commercial Vessels

SAR Area 010 is known for offshore fishing vessels incidents, specifically off Frobisher Bay in the Davis Strait.

From 2012 to 2016, there were three M1 and two M2 incidents with a fishing vessels. In these cases, JRCC was alerted directly three times while MCTS Iqaluit was alerted on two occasions. Examining the relative proportions of ***Figures 5, 6 and 7*** shows that the applicable JRCC is notified directly more often with commercial/fishing vessels distress incidents than in pleasure craft distress incidents. Faster response times are correlated with having JRCC as the first point of contact.

Commercial vessels directly alert one of; JRCC, MRSC St. John's or MCTS Iqaluit in SAR Area 010. Two M1 cases were part of the total case number (7), both medical evacuations.

Figure 6: SAR Area 010 Alerting Method from Fishing Vessels

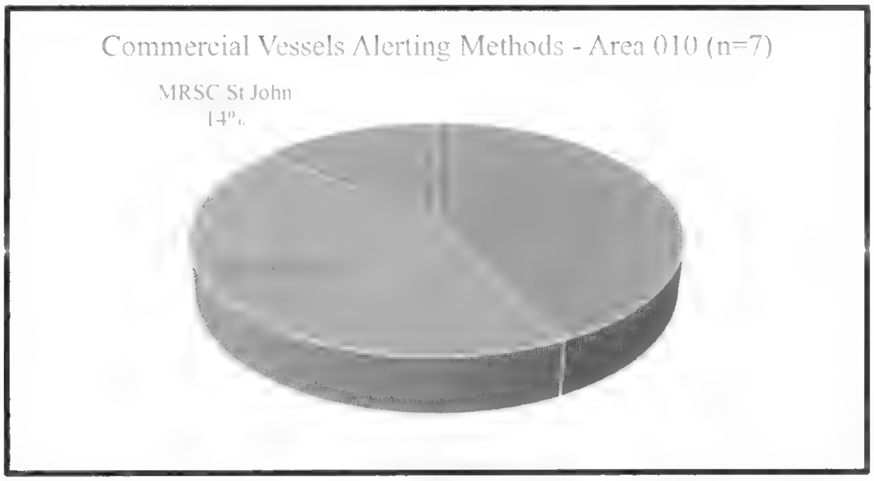


Figure 7: SAR Area 010 Alerting Method from Commercial Vessels

4.4 Monthly Distribution M1 Incidents

Figure 8 shows an overall picture of M1 cases that have occurred in SAR Areas 259, 260, 155 and 010. The results are generalized for the entire Arctic due to small data sets from individual SAR areas.

The greatest number of M1 incidents occurred in August 2012, with a peak of 4 cases. M1 cases peak during the summer months of August and September. The number of cases decreases after September. Notably, no M1 cases were reported in the Arctic from 2012 to 2016 for the months of March, April, May, November and December.

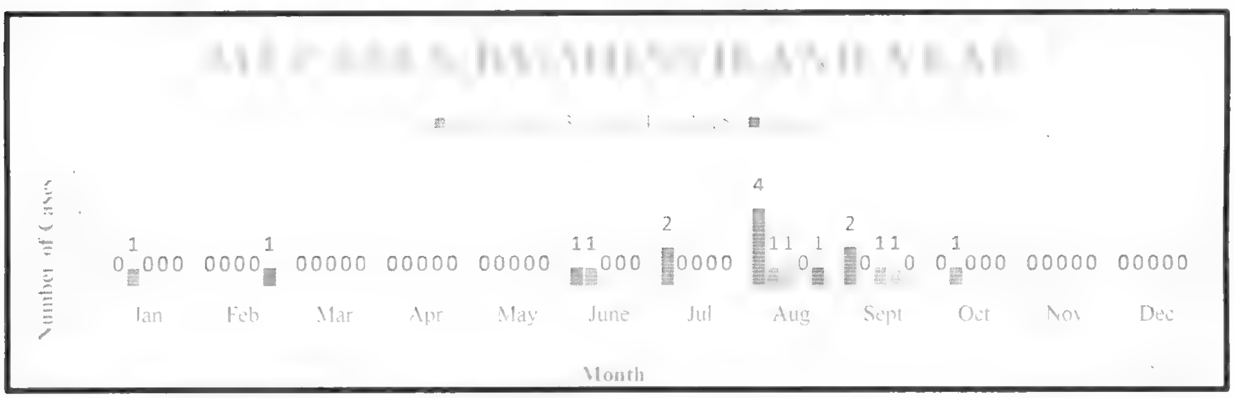


Figure 8: M1 Cases by Month and Year for SAR Areas 259/260/155/010

SAR Area 010 (n=10) was the busiest area for M1 cases, followed by SAR Area 155 (n=6), SAR Area 259 (n=1) and SAR 260 (n=1).

4.5 Monthly Distribution M2 Cases

Figure 9 shows an overall picture of M2 cases that have occurred in SAR Area 259, 260, 155 and 010. This section does not require a specific study on SAR Area 010 since the results can be generalized for the whole Arctic.

From 2012 to 2016, the months of July (n=10), August (n=11) and September (n=9) saw the greatest number of M2 cases. Throughout the period examined, there were no M2 cases were reported from December to May.

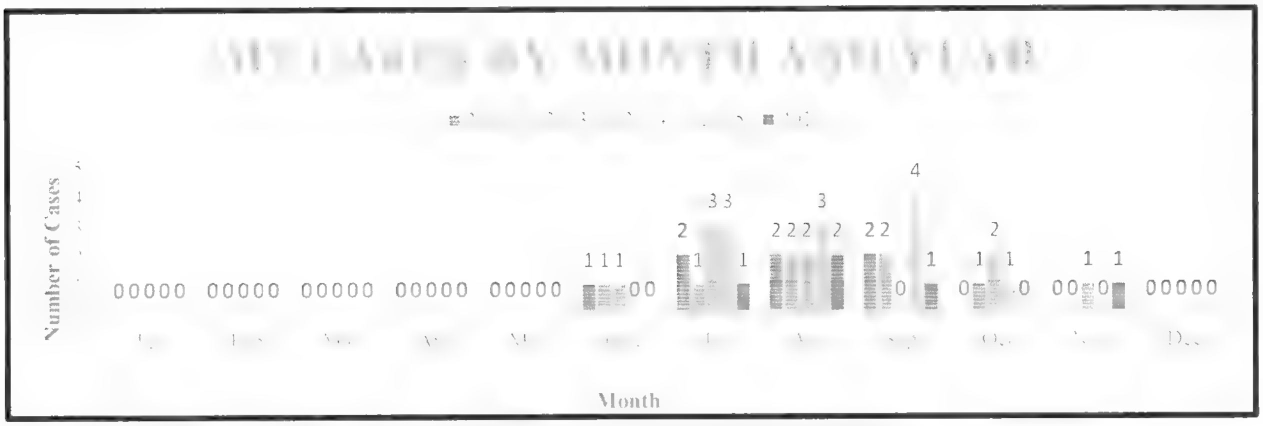


Figure 9: M2 Cases by Month and Year for SAR Areas 259/260/155/010

4.6 Monthly Distribution M3 Cases

Figure 10 shows an overall picture of M3 cases that have occurred in SAR Areas 259, 260, 155 and 010. This section does not require a specific study on SAR Area 010 since the results can be generalized for the whole Arctic.

The greatest number of M3 incidents occurred in August, with a peak of 30 cases combined over the five-year period examined. As expected, M3 cases tend to peak during the summer months; however, the Arctic does see marine cases through most of the year.

In sum, more M3 cases (n=75) were reported directly to JRCC when compared to M2 (n=39) and M1 (n=18). This is expected since M3 cases occur more often.

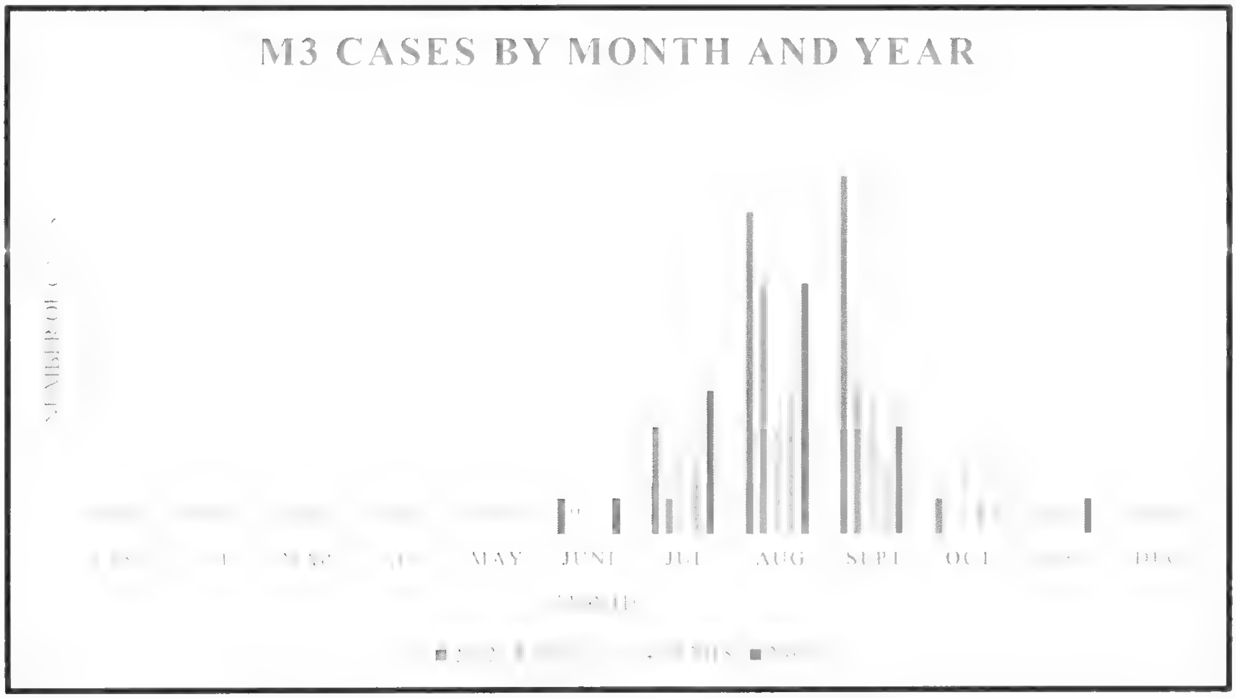


Figure 10: M3 Cases by Month and Year for SAR Areas 259/260/155/010

5. Distribution M1, M2, and M3 Cases

From 2012-2016; 18 x M1, 39 x M2 and 75 x M3 cases were reported to JRCC **for SAR Areas 259/260/155/010** combined.

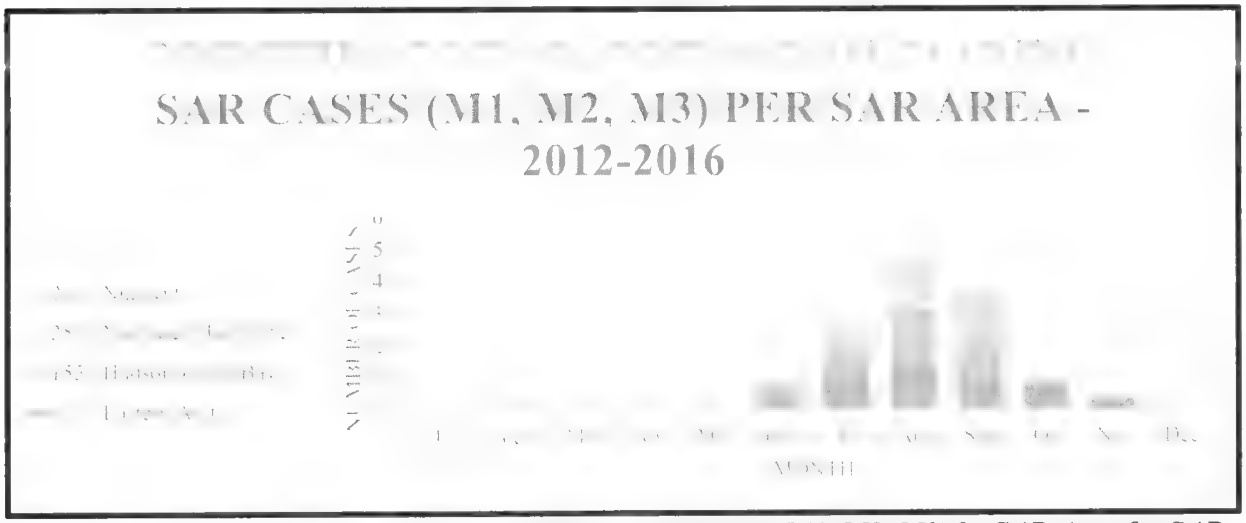


Figure 11: Monthly Five-Year Average of Marine SAR Cases (M1, M2, M3) by SAR Area for SAR Areas 259/260/155/010

The month with the highest average number of marine cases for SAR Areas 010 is August due to the high volume of seasonal pleasure craft, fishing vessels, and commercial traffic. Small craft can be found on the water at any time of year. If open water exists, Inuit are likely engaged in harvesting activities. A January 2013 example of an M1 case was 2 person overdue from a seal-hunting expedition. Late summer is when M1 to M3 cases peak in volume.

SAR Area 010 had 48 SAR cases during the 5-year period of study.

Table 1: Number of cases per community in SAR Area 010 (5-year period)

SAR Area	Number of communities	Number of cases	Total average (cases/community)
010	11	48	4.36

Through SAR partner engagement; it was identified that SAR statistics are underreported and the SAR case values presented in SISAR databases **do not capture all marine incidents**. From community engagement sessions; it was estimated that **the *actual* number of SAR cases that occur annually is 4-5 incidents per community**. In SAR area 010, this represents between 4.58 to 5.73 times as many incidents occurring as are reported. Without providing a number, JRCC relayed the same picture of SAR underreporting. Wherever assets are not available, the federal SAR system is not activated, thus presenting as if such an area has no need for SAR resources.

It was pointed out during our engagement sessions that each time the local SAR vessel is utilized in a community, it might not be to respond as what CCG would classify as a M1, M2, or M3 case. As an example, sometimes a community will ask their local marine SAR unit to bring kids on a traditional camp instead of using smaller vessels from the community to ensure safe passage. Tasking authorization for these type of SAR-prevention cases might be confusing. For locals it could equally be hard to understand why such request might be refused by a primary SAR asset.

6. Risk Matrix – Based on Five Years of Historical Data – 2012 to 2016

The risk portrayed in Figure 12 has been calculated using historical SISAR data from 2012 to 2016.

The criteria for determining how each category would be placed in the risk matrix (likelihood and impact) can be found in Tables 2 and 3.

Table 2 and 3 – Risk Matrix Likelihood Criteria and Risk Matrix Impact Criteria

Likelihood Legend		Range for likelihood number
Almost Certain	1 incident or more per week	52+
Likely	1 or more incident per month	11 to 51
Moderate	1 or more incident per year	1 to 11
Unlikely	1 incident every 10 years	0.1 to 0.9
Rare	1 incident every 25 years or more	0.04 to 0.09

Impact Legend	
Extreme	More than 50 at risk in incident.
High	More than 10 lives at risk in incident.
Moderate	More than 5 lives at risk in incident.
Low	One to five lives at risk in incident.
Negligible	No lives at risk in incident.

Impact						
	Extreme					
	High		**M1 Fishing**			
	Moderate					
	Low		**M2 Fishing, M1 Commercial, M2 Commercial**	**M1 Pleasure M2 Pleasure**		
	Negligible			**M3 Fishing M3 Commercial**	**M3 Pleasure**	
		Rare	**Unlikely**	**Moderate**	**Likely**	**Almost Certain**
		Likelihood				

Figure 12: Risk Matrix – Area 010

Overall, SAR incidents with pleasure crafts were found to have the highest likelihood. At times we found at least 20% of vessels from any given community in SAR Area 010 can be expected on the water on a nice day.

Incidents aboard commercial vessels from 2012 to 2016 only implicated most of the time one person who was requiring medical attention. In fact, out of the six calls (M1 and M2) involving commercial activity, five were due to symptoms of a heart attack or loss of consciousness. The exceptional cases were a group of seven persons filming a documentary with jet skis and one support vessel that requested evacuation once they encountered bad weather.

Finally, our results show M1 from a fishing vessel is unlikely every year compared to the majority of calls, but a greater impact on human lives is expected if such incident occurs. In this category, we highlight the case of fishing vessel Saputi that struck a piece of ice in 2016 and took on water with 30 POB.

7. Risk Scenarios – example of F/V Saputi

Risk scenarios presents general exposure to hazard and cases that can be expected in the Arctic. For SAR Area 010, Key Issues are highlighted and recommendations to mitigate those risks are presented. The list is then followed by a presentation of current SAR resources for SAR Area 010, 155, 259 and 260.

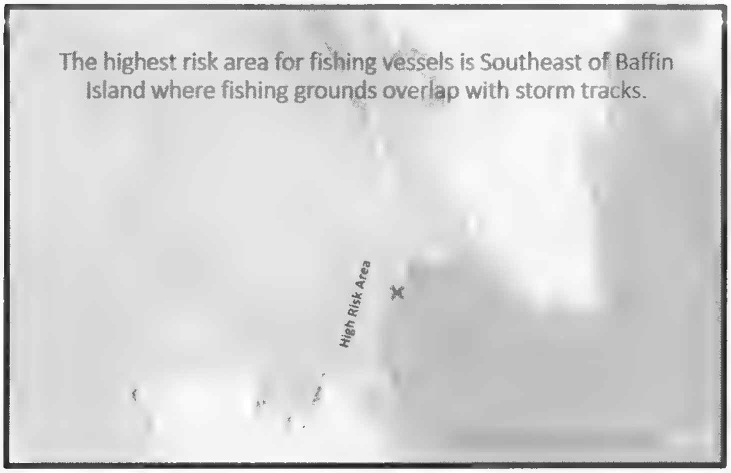


Figure 13: High Risk Fishing Area

As shown in the ***Figure 13***, F/V Saputi (represented by the X) struck the piece of ice close to a high-risk area that overlays with fishing zones. Fortunately, in this case, the fishing vessel was able to secure four pumps dropped by a 413 Squadron CC130 and proceed to secure alongside the dock at Nuuk harbour. However, this close call is an important reminder of the risk for fishing vessels of navigating between Baffin Island and Greenland.

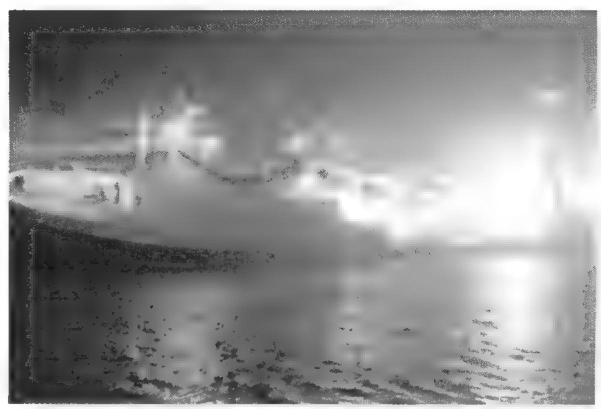


Figure 14 and 15: Before and After M1 Incidents for Fishing Vessel Saputi

8. Asset Response in Incident Resolution – (M1 to M3)

In the Arctic, multiple assets are tasked at the same time. During the same SAR case, assets can also have multiple sorties due to refuelling. The table below represents the number of times an asset was tasked for all SAR cases examined.

Multiple sorties or responding assets for the same SAR case are shown by the table below

Table 4: Resources Tasked - SAR Area 010 (n=48)

Unit Tasked	Number of Time Tasked	Source
N/A	0	Primary Maritime SAR
Total	***0***	
CCG Ship Opportunity	23	Secondary Maritime SAR
Federal Vessel	2	
Total	***25***	
CCGA	4	Other - Maritime
VOO Fishing	0	
VOO Commercial	3	
VOO Pleasure	10	
Provincial Vessel	2	
Total	***19***	
CORM	43	Primary Air SAR
HERC	37	
Total	***80***	
Various CF Air	2	Secondary Air SAR
CCG Air Opportunity	5	
Federal Aircraft	4	
Total	***11***	
CASARA	2	Other - Air
AOO Commercial	1	
Private Aircraft	20	
Total	***23***	
Grand Total	***158***	

In SAR Area 010, the far distance between southward Baffin Island, Nunavut and Greenwood, Nova Scotia, makes it difficult for Primary Air assets to arrive on scene in short notice. For SAR Area 010, the Hercules airplane has a reaction (wheels up) time of 30 minutes 40 hours per week, and a 2-hour reaction time otherwise. The endurance for a Hercules airplane is 7 hours (up to 11 hours given loading and fuel considerations) while the endurance for a Cormorant helicopter is 5 hours, which makes it sufficient to reach all of SAR Area 010. Along with Primary Air, other assets are often tasked for the same SAR case. Precisely, from 2012 to 2016, assets were tasked 158 times for a total of 48 cases, for an average of approximately 3 assets per SAR call.

While looking at the table above, we notice a high volume of vessels of opportunity (VOO). That is for us a concern since maritime SAR delivery in the Arctic has an element of luck that seems to be too often counted on. While Air Primary response is reliable, it is important to take into account the total response time (reaction and on route time) in incident resolution.

Figure 16: SAR Area 010 Incidents Locations

The following is a graphic depiction of the incident locations for SAR Area 010.

9. Maps of Canadian Coast Guard Auxiliary in the Arctic

In 2016, the Canadian Coast Guard Auxiliary (CCGA) was operating a unit in Pangnirtung in SAR Area 010.

Figure 17: Pangnirtung CCGA Range

The CCGA has seen tremendous growth in recent years all across the Arctic. For SAR Area 010, new units have been formed in Kuujjuaq and Kangiqsualujjuaq since 2016. In fact, since 2017, the Ocean Protection Plan's Community Boats Program and Auxiliaries Expansion Program in communities now have reduced barriers to entry into forming and funding CCGA teams.

9.1 Number of Cases Answered by CCGA

During the years of 2012-2016 seven CCGA-assigned cases out of the fifteen in the Arctic were responded to by CCGA Pangnirtung in Area 010 from 2014 to 2016. The eight other cases were in Area 155 and responded by CCGA in Rankin Inlet in 2012 and 2015-2016. Cases includes M1 to M4.

Table 5: Breakdown of Cases Answered by CCGA – SAR Area 010

Operational season	SAR AREA	Case summary
2015	010 (M1)	Local SAR in Pangnirtung advised that 2 local hunters are 24hrs overdue seal hunting, NW of Bon Accord Harbour. CCGS DesGroseilliers, a Hercules aircraft, and a Corm helicopter have been tasked to assist. Hunters located on a small island, all ok. Their boat had sank. Case closed.
2014	010 (M2)	Iqaluit EMO reported that a 24-foot green freighter canoe with 70-horsepower engine was overdue with three people on board; their last known position was on the Western shore of the Cumberland Sound, NU. The missing boat was found by another group in the area. They were taken back to Pangnirtung by CGA Unit 527.
2015	010 (M2)	JRCC Trenton passed call from CCGA member Peter Kilabuk that reported 3 hunters that were stuck on the ice in Cumberland Sound near Pangnirtung. CCGS DesGroseilliers and Hercules R344 tasked to assist. After further investigation, Peter Kilabuk reported that the 3 hunters had walked to shore and had been picked up by family members. All assets stood down. Case closed
2014	010 (M3)	24 foot freighter canoe with 5 POB overdue returning to Pangnirtung, Nunavut. SPOT distress beacon on board the vessel was activated, giving a position on Imigen Island in Cumberland Sound. CGA Pangnirtung proceeded with two vessels to Imigen Island and discovered that the vessel was disabled on the island and unable to return to Pangnirtung. CCGA Pangnirtung towed the vessel to Pangnirtung. Case closed.
2014	010 (M3)	CCGA member in Pangnirtung reports a group of 4 hunters are stranded due to a disabled vessel approx. 40nm West of Pangnirtung, NU. CCGA tasked towed back to Pangnirtung.
2015	010 (M4)	EMO NU reported detecting that the help button on a SPOT beacon had been activated. The beacon belonged to a 24 foot green freighter canoe in the Cumberland Sound. CCGA PANGNIRTUNG could not respond due to ice in Cumberland Sound. A 413 Sqn Hercules aircraft (R344), 103 Sqn Cormorant helicopter (R910) and CCGS PIERRE RADISSON were tasked. R344 located the contacted persons of concerned and delivered a radio message dropper. Through radio transmissions, they

		confirmed that there was no distress and that the beacon had accidentally been activated. Case reopened due to a subsequent transmission, CGA Peter Kilabuck has contact with one party who advises Zarachy left the site to walk to Pangnirtung July 11th. Zarachy was picked up by helicopter while the boat owner stayed at a cabin with a radio. Case closed.
2016	010 (M4)	A 22 foot freighter canoe reported overdue returning to Pangnirtung, Nunavut. CGA tasked to investigate. Determined that the overdue party had decided to stay out overnight and were not in any distress.

In total, Pangnirtung CCGA was tasked to respond for one M1 from 2012 to 2016. Two cases were classified as M2, two cases were classified as M3, and two were classified as false alarm (M4).

Looking solely at these statistics, it could be hard to understand how much CCGA contributes to maritime Search and Rescue in the Arctic due to the limited amount of tasking. However, from our engagement with the Joint Rescue Coordination in Halifax and Trenton, it was clear how a CCGA unit have a significant impact on a community's SAR capacity. As an example, Pangnirtung CCGA responded to seven cases from 2014 to 2016, but was not active in 2012 and 2013. During 2012 and 2013, no cases involving pleasure crafts were reported to JRCC nearby Pangnirtung. Accordingly, such results seems to illustrate how successful CCGA units do get tasking and how they allow locals to be a part of the national SAR system.

Furthermore, a CCGA unit creates a safety culture in the community that cannot be underestimated. Programs such as the Inuit Marine Monitoring Program, the Operation Life Preserver Project, or the Guardian Program all correlate with the broad CCGA and CG mission of SAR.

Finally, standard operations and procedures from CCGA required involvement with JRCC. If more units are created and training program are provided, the numbers of tasking to Arctic CCGA unit are expected to increase in the upcoming years. It is important to note only two communities had a local CCGA unit deployed on a tasking in the Arctic from JRCC from 2012 to 2016.

However, this is expected to increase. Close monitoring of the workload for JRCC SAR Mission Coordinators (SMC) is recommended.

10. Upcoming Arctic SAR Assets

From our SISAR data base, we were able to categorize the busiest communities in the Arctic that might require options such as CCGA, including Nunavut and Nunavik. Highlighted in green represents the communities with an operational CCGA. Highlighted in yellow represents the communities where the creation of an CCGA unit by the end of 2019 has been proposed

Table 6: Number of calls per community with current or upcoming Arctic SAR assets – SAR Area 010

Area 010
Cape Dorset (7)
[redacted] (6)
Iqaluit (5)
Qikiqtarjuaq (4)
[redacted] (1)
Kimmirut (1)

Incidents in the ***Table 5*** includes M1 cases. Even with limited date, JRCC (Halifax and Trenton) are aware 83.33% of the time for all M1 SAR cases. As part of the analysis, we are interested to look into the location of M1 SAR cases to understand where the highest demand in maritime SAR for the Arctic exists, including in SAR Area 010.

During our engagement, it was found the Arctic could be home to 232 cases per year. Most of these cases being M2 and M3 in severity, which is a large increase in the 132 M1 to M3 cases observed from 2012 to 2016). Engagements also noted a confirmation bias in SAR statistics. Wherever assets are not available, the federal SAR system is not activated, thus presenting as if such an area has no need for SAR resources.

CCGA units have responded to one M1 case from 2012 to 2016, with most of their taskings being provided to assist in M2 and M3 cases. Below is the breakdown for M1 incidents.

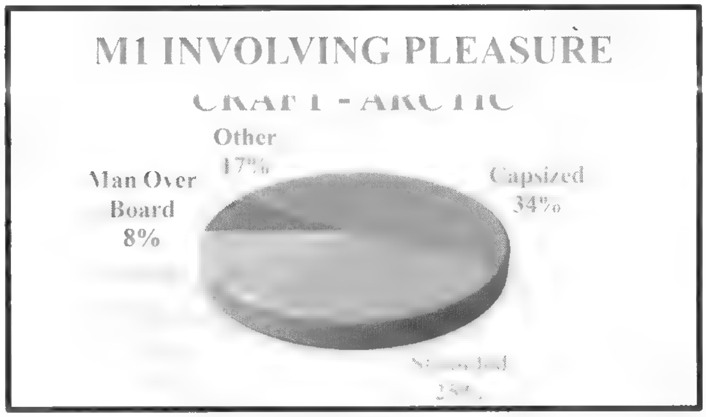
Table 7: M1 Incidents by Type

Vessel Type	Fishing vessel	Commercial	Pleasure craft
M1 - Arctic	3	3	12

Out of the 12 cases involving a pleasure craft from 2012 to 2016, the locations were as follows (in bold representing SAR Area 010):

1. Pond Inlet (Nunavut)
2. Tuktoyaktuk (NWT)
3. **Ungava Bay** (community unknown)
4. Foxe Basin (communities of Hall Beach, Cape Dorset, Naujaat and Coral Harbour)
5. Moosonee (James Bay Area)
6. Gillam (Manitoba)

7. Puvirnituq (Nunavik)
8. Churchill (Manitoba)
9. **Iqaluit (Nunavut)**
10. Igloolik (Nunavut)
11. **Pangnirtung (Nunavut)**
12. **Cape Dorset (Nunavut)**



Out of these 12 communities, only three currently have an operational CCGA unit (Pangnirtung, Tuktoyaktuk, and Churchill). However, we evaluate that all of these cases could have been responded to by a well-trained CCGA unit. The adjacent figure represents the incident breakdown. Two incidents are categorized as "other" (1 SPOT activation resulting in chartered helicopter extraction and 1 out of fuel vessel resulted in POB transported back by the CCGS Eckaloo).

Figure 18: M1 Incidents Involving Pleasure Craft from 2012 to 2016 - Arctic

In sum, this analysis of M1s reinforced the argument for CCGA Central & Arctic Inc. to establish CCGA units in **Cape Dorset and Iqaluit**, **to continue the expansion in Qikiqtarjuaq**, and **reinforce the training in Kuujjuaq and Kangiqsualujjuaq**. Further engagement is recommended in Quaqtaq, Kangirsuk, Aupaluk and Tasiujaq to confirm if more potential cases than expected is occuring in those communities. If such is the reality, a CCGA unit would be recommended for these communities as well. Finally, for the busiest communities currently lacking primary or secondary SAR station such as Cape Dorset and Iqaluit, an IRB-N station should be considered.

10.1 Limitations of IRB-N

Implementing an IRB station at a specific location is a complicated process, with numerous additional considerations to be expected, including cost to the Crown, logistics, community services and support, transportation schedules, and freight availability as commercial contracts are a common occurrence for a station start-up.

With those considerations, a trade-off with factors outside the scope of the RAMSARD report is required. For example, as identified in our environmental scan, when the ice-out and ice-in dates are is an important factor when considering the implementation of an IRB-N station. Given the large investment, it would be beneficial having operational assets for a whole operational season (i.e., Mid-May to Mid-September as is the case for Rankin Inlet, but this might not be the case for other busy areas such as Pond Inlet or Arctic Bay. Furthermore, IRB-N crewmembers might not be from the communities that they'll be serving, therefore limiting the knowledge on local hazards. In those cases, the establishment of a CCGA unit might the best option. For SAR Area 010, considering the numerous navigational challenges in Frobisher Bay, as an example, the establishment of a CCGA unit might the best option.

10.2 Limitations of CCGA Units

However, there's limitations as well on what can be expected from a CCGA unit, specifically in the Arctic. According to Canadian Aeronautical and Maritime Search and Rescue (CAMSAR), Canadian Coast Guard Auxiliary (CCGA) are considered an "other resource", and not a primary or secondary resource, as they do not maintain a 30 minute SAR standby posture and are not owned by the Federal Government.

10.3 Fleet role in Arctic engagement

Discussion about Fleet's potential roles in Arctic Engagement and CCGA SAR unit exercising and other community based events are still on-going. Very successful engagement that "placed a strong emphasis on Indigenous community engagement and marine safety in remote communities"[1] occurred during summer 2018. Since the summer of 2017, the Canadian Coast Guard has also deployed Arctic Community Engagement and Exercise Teams. These teams travelled to a number of Arctic communities and focused on providing training to local maritime SAR units.

11. Resource Response Times in Incident Resolution

11.1 Air SAR Primary Response

The CF – Primary SAR Air SRU's are the only resources – marine and air – that were tasked at least once in the Arctic for each year from 2012 to 2016. Two Primary Air assets in SAR Area 010 were utilized during the years of this analysis. The Hercules Airplane and the Cormorant Helicopter from JRCC Halifax. These assets were tasked to respond to incidents in Area 010 a total of 37 cases, an average of approximately 7 cases per year.

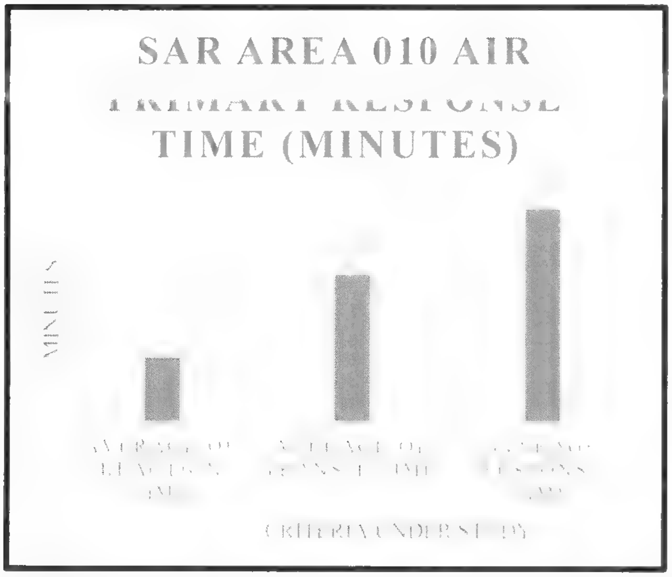
In SAR Area 010, there are no RCAF aircraft in for SAR unless JRCC Halifax task a primary SAR resource from Gander or Greenwood. Hercules are able to conduct longer flights and act as a platform for SAR Techs to launch from.

Table 8: JRCC Halifax Air SAR Primary Options

Type	# Available	Mandated Reaction Time	Fuel Endurance	Crew	Crew Schedule
CC130 Hercules	2	30 min. between 8-4 on weekdays, 2 hrs after hours and on weekends	11 hr.	7 Crew 2 SAR Techs	12 hr. flight time 3-5hr additional ground time
Cormorant (103 Squadron)	1	30 min. between 8-4 on weekdays,	5 hrs	3 Crews 2 SAR Techs	12 hr. flight time 3-5hr additional ground time

[1] https://www.myalgoma.ca/2018/09/17/indigenous-community-engagement-and-a-safe-sealift-highlight-ccgs-samuel-risleys-maiden-arctic-voyage/

2 hrs after hours
and on weekends



Reaction Time: Time from assignment of tasking to SRU departing base.
Transit Time: Time from departing base to on scene.
Response Time: Reaction + Transit time.

Figure 19: SAR Area 010 Air Primary Response Time (Minutes)

Along with Primary Air sorties, a SAR call in the Arctic usually results in JRCC multi-tasking assets (meaning a number of assets are tasked to the same SAR call). In SAR Area 010, there was no primary marine SAR, but numerous secondary marine SAR, other and vessels of opportunity. To better understand what assets are available for SAR Area 010, the next section examines their response time.

12. Secondary, Other, and Vessel of Opportunity Response

Figure 10.1.2 includes all tasking's issued by JRCC for marine cases during the years of the analysis. This section will discuss all Other SRUs that were utilized from 2012-2016 to respond. This section does not require a specific study on SAR Area 010 since the results are generalized within the whole Arctic.

According to CAMSAR:

- ***Secondary Units*** – are all units of the Federal government that are not primary search and rescue units but which may be tasked to aid in the resolution of a search and rescue incident.
- ***Other Units*** – units, other than primary or secondary search and rescue units, which participate in search and rescue activities when required.
    - This includes civilian agencies, volunteers and partially Federal Government funded facilities such as the Canadian Coast Guard Auxiliary and the Civil Air Search and Rescue Association.

There were five responding Secondary SRU units tasked for a total of 53 times in the Arctic. The Secondary SRUs responded to16.16 % of cases.

CCGA, CASARA, and Commercial Vessel and Aircraft all had a share in the SAR responses. 126 taskings were issued to these Other Maritime SRUs. This equates to 'other' resources responding to 38.41 % of all maritime tasking. The average response times are outlined in ***Figure 19.***

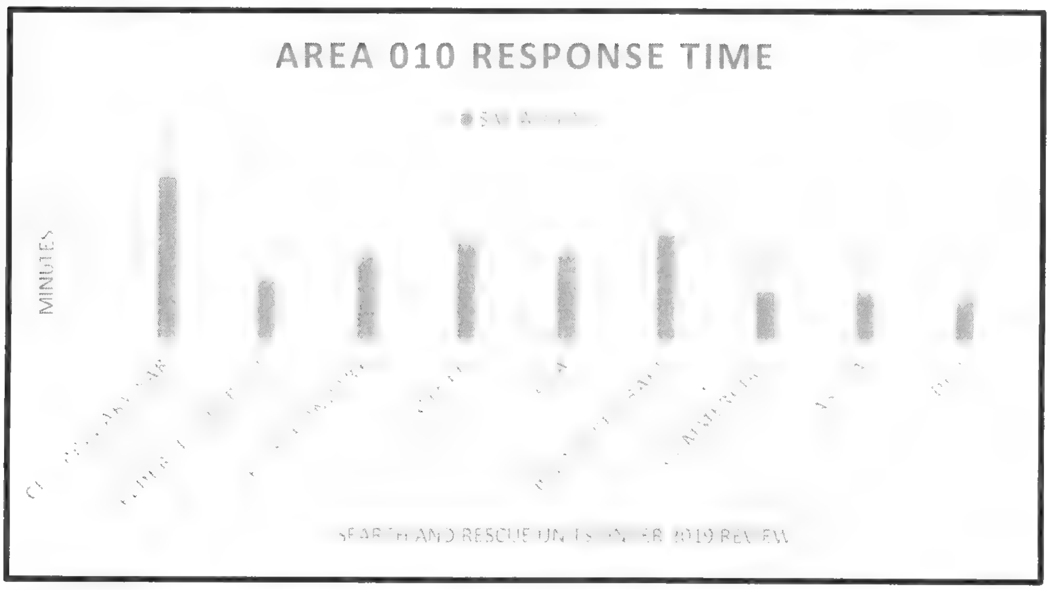


Figure 20: 010 Average Response Time (2012 – 2016)

13. Summary of Incident Data Review and Analysis – Area 010

- There were to 132 SAR cases (M1 to M3) in the Arctic from 2012 to 2016.
- Cape Dorset (n=7), Pangnirtung (n=6), Iqaluit (n=5) and Qikiqtarjuaq (n=4) are respectively the busiest communities in SAR Area 010.
- Area 010 is the only area with incidents involving fishing vessels (total of 15 M1 to M3 cases).
- JRCC Halifax is contacted first in 7% of M1 to M3 cases involving pleasure craft in SAR Area 010.
- JRCC Halifax is contacted first in 53% of M1 to M3 cases involving fishing vessels in SAR Area 010
- SPOT beacons activation in Nunavut is on the rise.
- EMO Nunavut is contacted first in SAR Area 010 (46%) and 260 (41%) for M1 to M3 cases involving pleasure craft. JRCC Trenton is contacted first in SAR 155 (24%). In SAR Area 259, RCMP has the lead with 62 % and MCTS Iqaluit receiving the remainder (38%).
- JRCC Trenton and JRCC Halifax were only alerted first in 20% of the 106 cases that involved a pleasure craft from 2012 to 2016.
- The month with the highest average number of marine cases for SAR Areas 010 is August.
- JRCC Halifax averages 4.36 cases/community per span of five years while JRCC Trenton averages 1.79 cases/community.
- For every M1, JRCC is activated five times out of six in the Arctic.
- SISAR numbers are not accurate, especially M2 and M3. We estimate 4/5 M2 or M3 per community per year.
- Out of the six calls (M1 and M2) involving commercial activity, five were due to symptoms of a heart attack or loss of consciousness.
- In SAR Area 010, local CCGA had a role in 3% of incident resolution

13.1 Risks Identified in Environmental Scan – Area 010

1. Commercial fishing fleets in Davis Strait are exposed to powerful storms throughout the boating season, especially autumn.
2. Small craft regularly transit 300-400nm between communities along exposed shorelines.
3. Large tides up to 17 meters along with strong currents affect all of SAR area 010 daily.
4. All commercial vessels serving Arctic communities must pass through the Davis Strait, a body of water prone to storms.
5. Hudson Strait has strong tides, thick fog, and dense ice floes all summer long – making commercial shipping a challenge.

14. SAR Partners Engagement

SAR Operations Officers met with JRCC Trenton and Halifax, the Regional Operational Centre in Montreal, MCTS Iqaluit, and attended Mass Rescue Operations Workshop with numerous Arctic SAR partners and stakeholders to verify research findings of chapter four to eight. For SAR Area 010, engagement sessions were held in Pangnirtung and Qikiqtarjuaq to identify shared local hazards and boating trends.

15. Meeting the CCG Performance Standard

According to the Coast Guard Levels of Service and Service Standards 2007, the Coast Guard has set a Performance Standard level of 90% of lives at risk being saved in conventional cases. The performance standard is expressed as a percentage and is calculated using the formula:

$$\frac{\textit{Lives Saved}}{\textit{Lives at Risk}} \times 100\% = \textit{Performance}$$

$$\textit{Lives Saved} = (\#\ \textit{people saved from imminent danger})$$
$$\textit{Lives at Risk} = (\textit{lives saved} + \textit{lives lost} + \textit{lives missing})$$

The table below in ***Table 9*** shows the total number of people involved in M1 and M2 cases only. M1/M2 cases may have a combination of people assisted, saved, lost and missing.

M3 cases are not considered when calculating the performance standard as no risk to life exists. Similarly, POB 'assisted' are not included as 'saved' because their lives were never at risk. A distress call can arise when just one person on-board a vessel is facing a life-threatening situation.

Table 9: 2012 – 2016 CCG Performance Standard for SAR Area 010

Year	Number of POB (people on board)	Number of POB Assisted	Number of POB Saved	Number of POB Lost	Number of POB Missing	Result %
2012	6	0	4	1	1	66.67
2013	14	0	14	0	0	100.00
2014	23	0	23	0	2	100.00
2015	7	0	7	0	0	100.00
2016	31	0	30	0	1	96.77
Totals	**81**	**0**	**78**	**1**	**2**	**96.30**

For the years of this analysis in Area 010, the Coast Guard failed to meet the performance standard during 2012. However, the Coast Guard has achieved an overall Performance Standard of 96.30%, which is above the acceptable standard of 90%.

As defined in the Canadian Coast Guard Level of Service - Service Standards, June 2004 - 90% effectiveness is expected to be achieved during "conventional incidents" in which:

a. resources are able to respond within a short period of time;
b. the search object is located by the responding resource on scene in a timely manner;
c. environmental, geographic, and hydrographic conditions have little impact on the

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Annex A: Environmental Scan

SAR Area 010

Search and Rescue Risk Analysis

Canadian Coast Guard
Search and Rescue Risk Analysis
March 2019

Annex A: Environmental Scan – Area 010

The authors would like to extend acknowledgement to the following organizations:

Canadian Hydrographic Service
Canadian Ice Services
Department of Fisheries and Oceans
Environment and Climate Change and Climate Change Canada
Joint Rescue Coordination Centre Trenton and Halifax
National Oceanic and Atmospheric Administration
National Aeronautics and Space Administration
Oceans Ltd

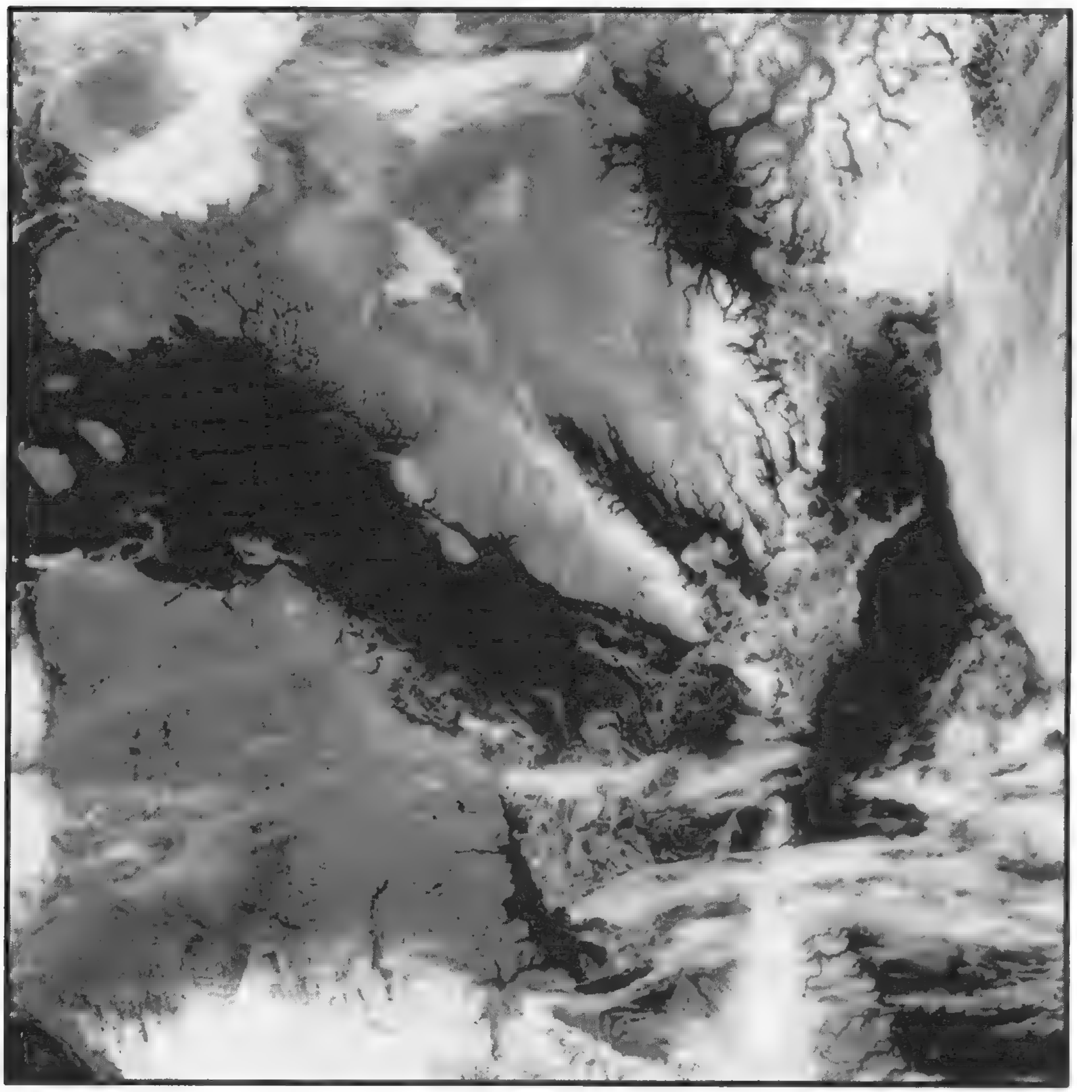


Figure 1 – Composite satellite imagery of prominent features in SAR Area 010 including Hudson Straight, Ungava Bay, Frobisher Bay, and Cumberland Sound. (July 20, 2018)

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Annex A: Environmental Scan – Area 010

Executive Summary

Search and Rescue (SAR) Area 010 underwent a Search and Rescue Risk Analysis (SARRA) Study using the Risk Based Analysis of Maritime SAR Delivery (RAMSARD) Methodology to study climate, geography, demographics, and human activity in the Arctic. The Environmental Scan is an important aspect of the risk analysis process and was designed to help evaluating risks to mariners in Search and Rescue Areas (SRA) on Coast Guard mandated waters. Environmental scans can help the Canadian Coast Guard (CCG) shape its resource management plans in response to rapids changes and create a vision of future requirement.

Summarized findings

- ❖ The Davis Strait is routinely prone to gale-force storms with 10m waves. This section of ocean is also a popular commercial fishing area.
- ❖ Small craft 18' to 26' regularly travel distances of 300-400 nautical miles over exposed coastline to transit between communities.
- ❖ Every community in SAR area 010 except Qikiqtarjuaq is affected by considerable tides (7 to 17 meters) and strong tidal currents. Most waterways close to shore pose a hazard for small craft due to shoals.
- ❖ Second year ice from Foxe Basin can be found drifting through Hudson Straight and lingering in Ungava Bay exceptionally late into the boating season.
- ❖ With rising temperatures; Kuujjuaq and Kangiqsualujjuaq will be the first communities to remain ice-free year-round.
- ❖ It is estimated that 8071 people go boating at least once per year in SAR Area 010.
- ❖ Iqaluit, Kuujjuaq, Pangnirtung, and Cape Dorset receive just over 50% of all commercial vessel traffic in the region.

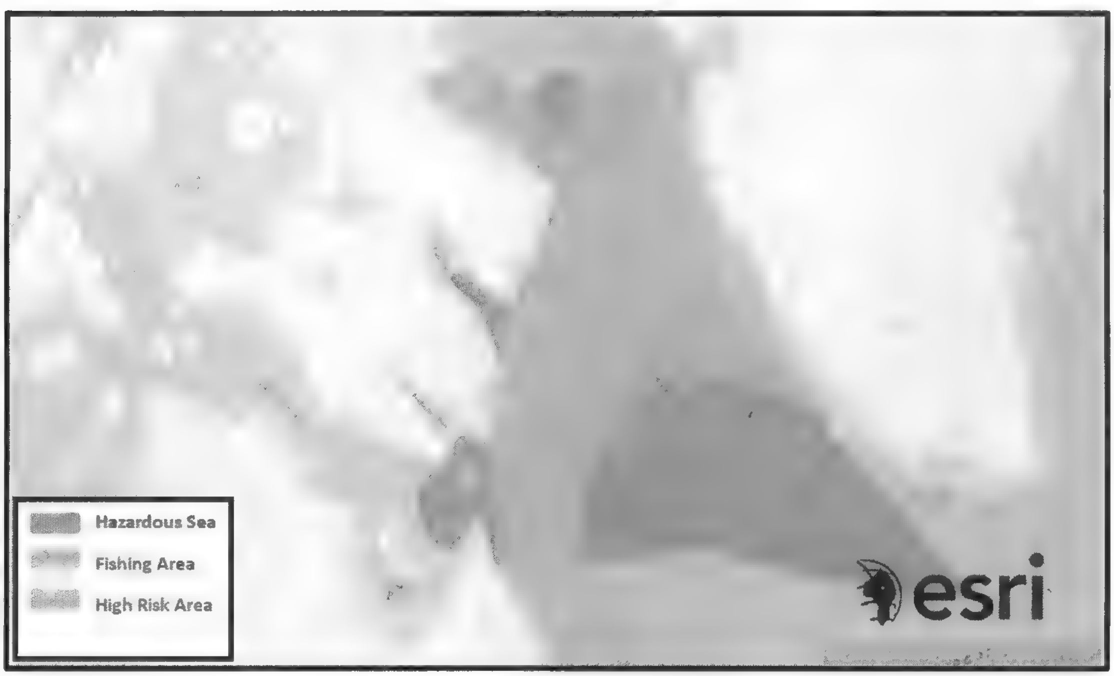

Figure 2 - Overview of Hazards in SAR Area 010

1. Maps of SAR Area 1.1 Maps

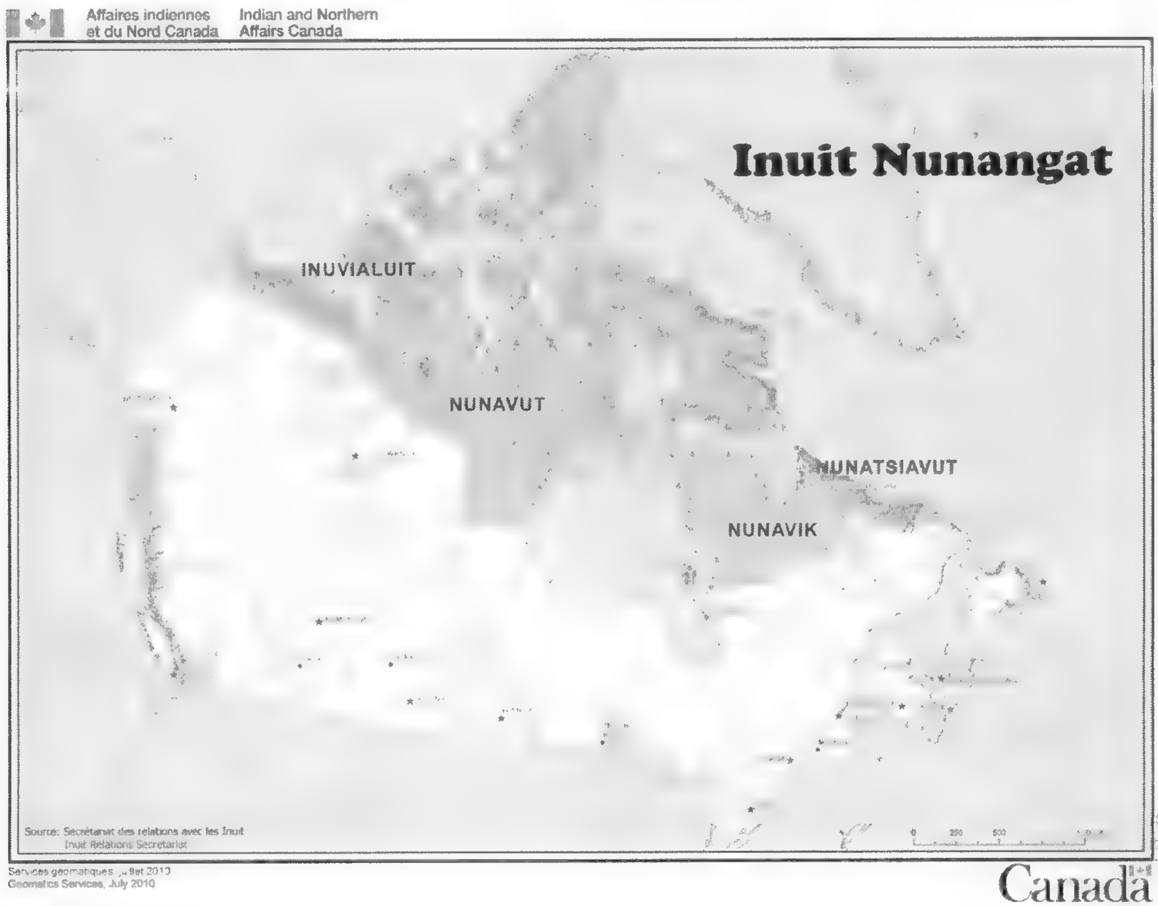

Figure 3 – Inuit Nunangat of Canada

Annex A: Environmental Scan – Area 010

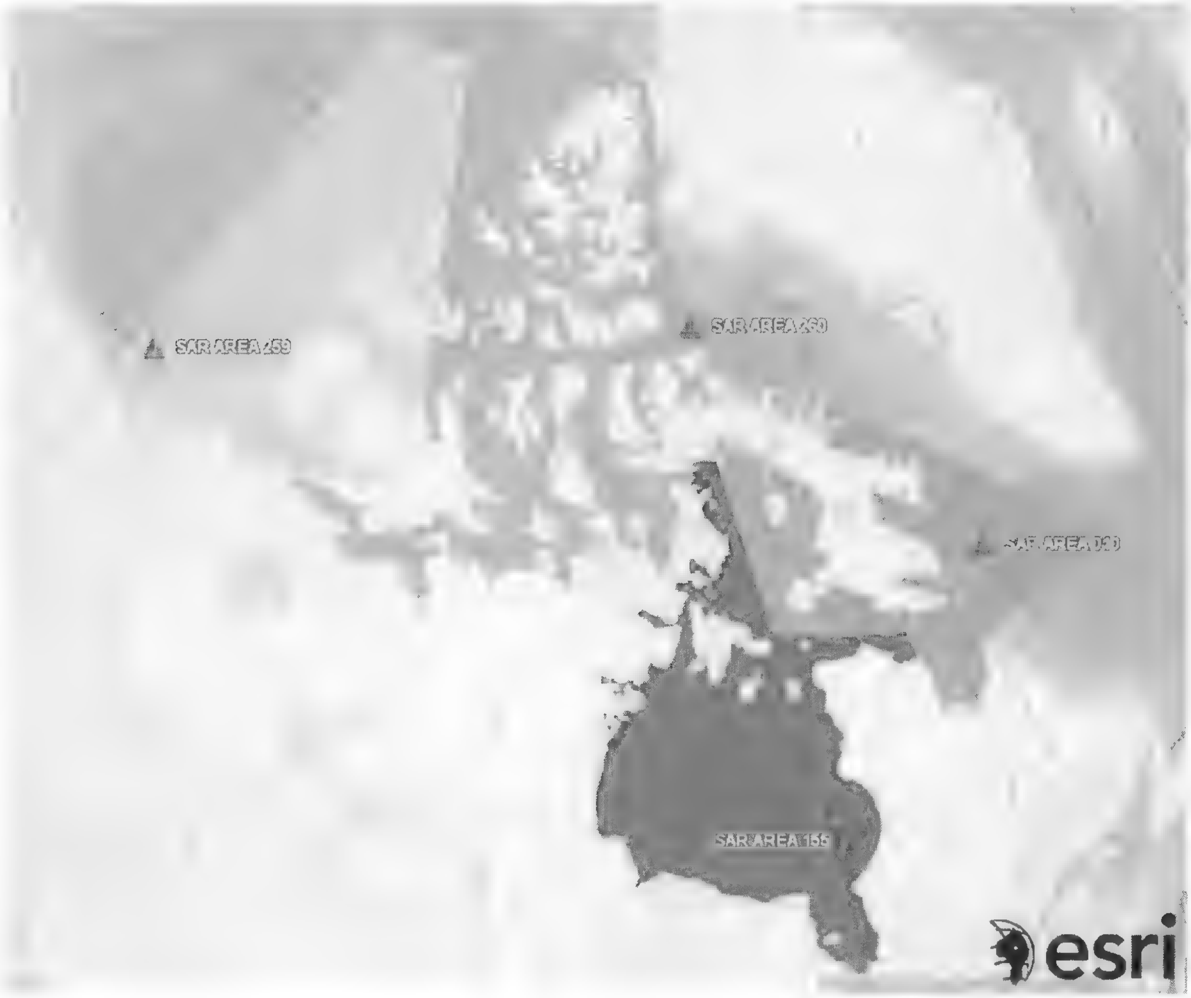

Figure 4 – RAMSARD Defined Regions of Study. The Canadian Arctic includes SAR Areas 010, 155, 259, and 260. These are the boundaries of maritime SAR.

Annex A: Environmental Scan – Area 010

*Figure 5 – Imagery of SAR Area 010 with Boundary Defined. *Does Not Include Inland Bodies of Water on Baffin Island.*

1.2 Description of Dimensions & Distances

SAR Area 010 encompasses sections of the North Atlantic, Labrador Sea, and Arctic Ocean in the Canadian Arctic Archipelago. Prominent features include Davis Straight, Hudson Straight, Foxe Basin, Cumberland Sound, Frobisher Bay, and Ungava Bay. The area defines the shoreline of Baffin Island South of 70°N, and does not include inland bodies of waters on Baffin Island.

The area encompasses 693 477 km^2 (202 186 NM^2) of ocean with an approximate shoreline length of 9528 km (5144NM).

The SAR Area is defined by the following list of coordinates (as created by the Department of National Defense for statistical purposes);

1. 70° 0'0.00"N 80° 0' 0.00"W
2. 70° 0'0.00"N 66° 4' 35.00"W
3. 65° 0'0.00"N 57° 45' 0.00"W
4. 63° 0'0.00"N 55° 40' 0.00"W
5. 58° 30'0.00"N 50° 0' 0.00"W
6. 60° 0'0.00"N 56° 40' 0.00"W*
7. 62° 0'0.00"N 70° 0' 0.00"W*
8. 64° 0'0.00"N 80° 0' 0.00"W

The boundary between coordinates 6 and 7 is defined as a line extending West from point 6 at 60°N until it reaches the shore of Labrador – from which point the boundary encompasses the shoreline of Ungava bay until reaching 70°W, where it extends North to meet coordinate 7.

The Joint Rescue Coordination Centre in Halifax, NS is responsible for SAR coordination in this SAR Area.

2. Climatology & Oceanography

Numerous climate factors have a significant impact on the SAR program. The examination of climate by season in each SAR area are conducted using 30 year climate normals for climate parameters including: prevailing wind direction, mean seasonal and maximum wind speed, percentage frequency of wave height greater than 2.0 metres, mean air temperature, mean seasonal minimum sea surface temperature, percentage frequency of visibility less than 1 nautical mile, percentage of fog occurrence, mean seasonal maximum of current speed, mean seasonal sightings of icebergs, mean days per season of ice coverage with concentration greater than 7/10ths and thickness greater than 15 cm, presence of old ice and first-year ice.

After the presentation of the climate factors significant to the SAR program for each main area of SAR Area 010, a brief narrative about the effect on climate change on ice season, population, micro-climates, precipitation and winds are revealed. Finally, main findings for navigational risk in SAR Area 010 are presented.

For the purposes of this environmental scan, the seasons are defined[1] as:

- Winter – December, January, February
- Spring – March, April, May
- Summer – June, July, August
- Fall – September, October, November

[1] Climate of the Canadian Coast Guard SAR Areas, 2018.

2.1 Prevailing Wind Direction

Prevailing wind direction in SAR Area 010 is from the Northwest with a shift to West-Northwest during spring and summer.[2]

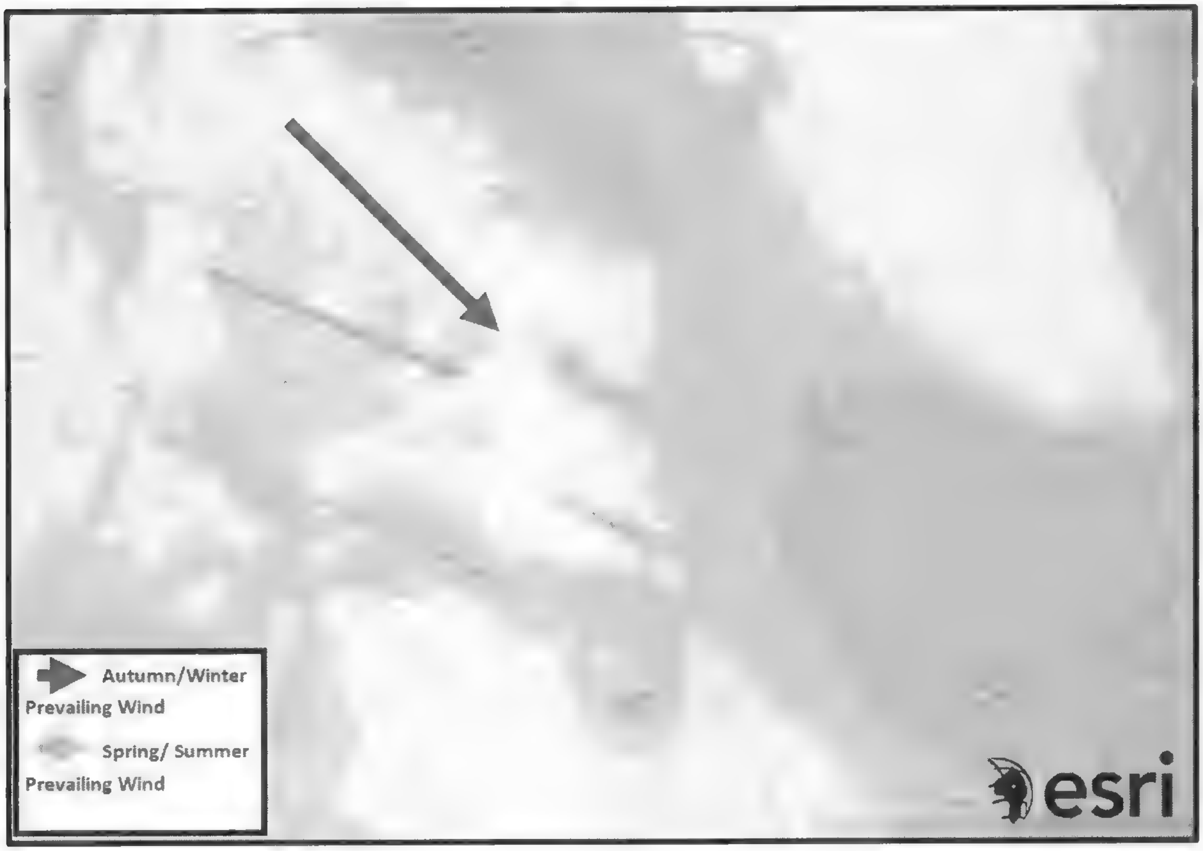

Figure 6 - Prevailing Winds in SAR Area 010

[2] Climate of the Canadian Coast Guard SAR Areas, 2018.

Storms affecting the area form over the North American continent, where they routinely track from the East for higher latitudes; such as low pressure systems 3 and 4. Storms also approach from the Southeast out of the Labrador Sea (the basin between Labrador and Southern Greenland) towards the Hudson and Davis Straights, such as in example 8, 14, and 15. Storms are most prevalent in autumn and winter.

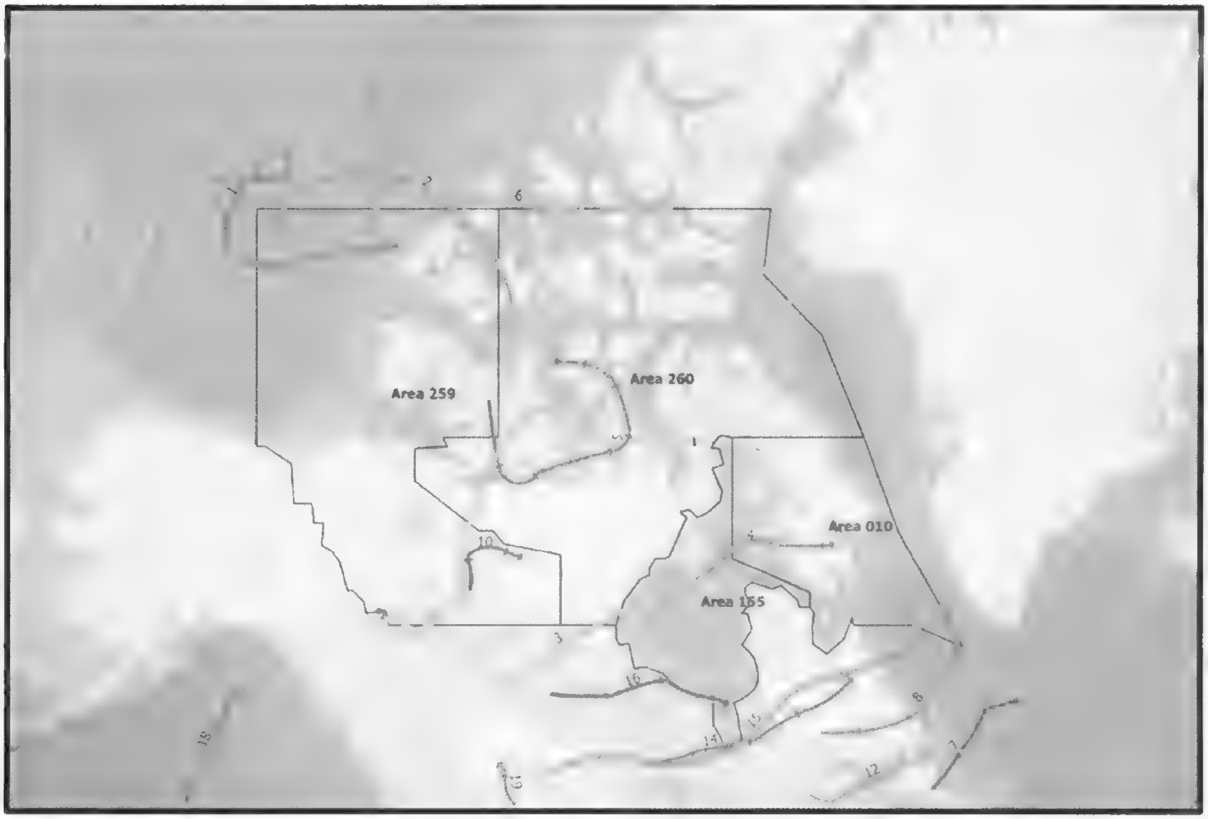

Figure 7 – Summer Storm Tracks Routinely Track from the West and Southeast.

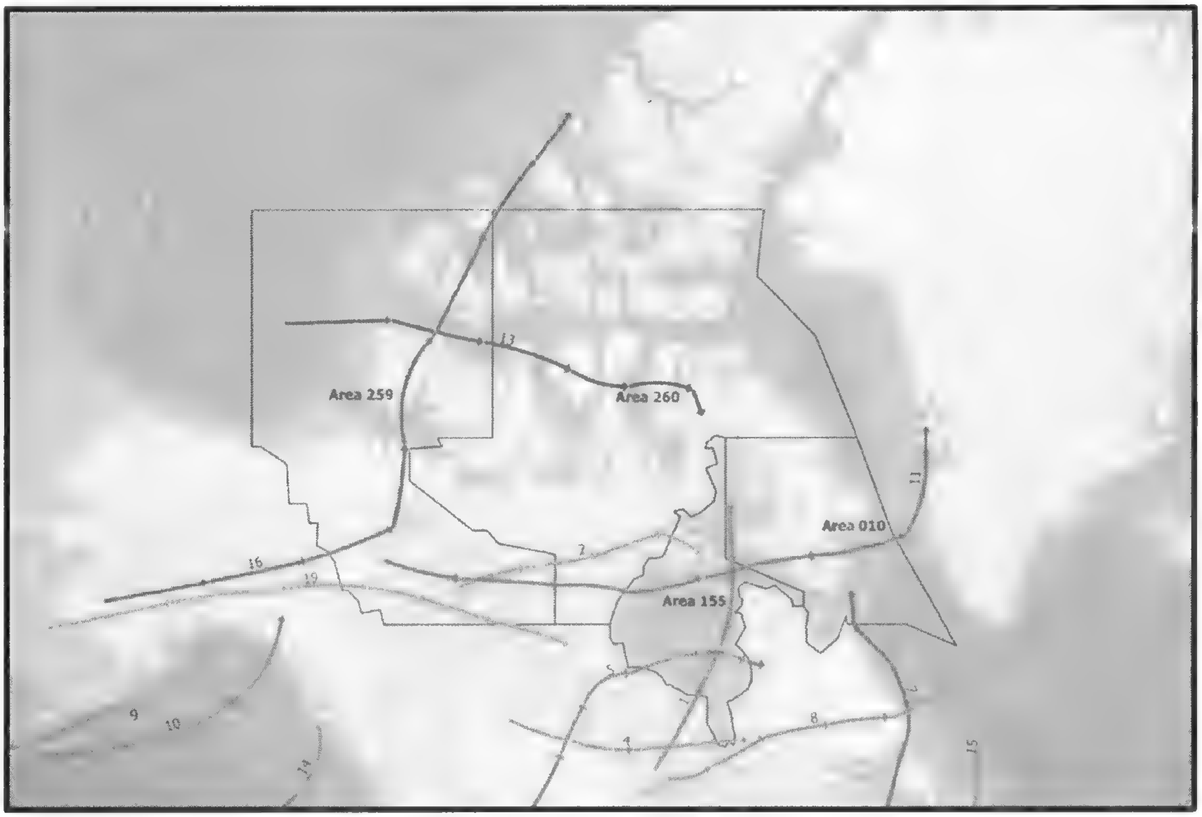

Figure 8 – Autumn Storm Tracks in SAR area 010 Typically Approach from the West or the South.

The presence of costal features significantly influences local wind conditions. The high prevalence of fjords on the East coast of Baffin Island result in strong katabatic outflow winds as cold air masses over glaciers and snowpack sink towards sea level through these narrow valleys. Such conditions can arise quickly and pose a hazard to small craft. Most settlements lie on windward shorelines to some degree. Offshore winds minimize the impact of wind waves affecting ports. This weather occurrence also aids in the expedited fracture and dispersion of sea ice towards the Labrador Current during summer.

Table 1 – Mean Seasonal Wind Speed

Season	Mean	Mean Maximum
Winter	17.5	39.7
Spring	13.4	33.4
Summer	10.5	28.7
Autumn	16.7	39.2

Summer wind conditions are relatively light while the autumn boating season sees worsening conditions. Gale force winds (>34kts) are more frequent during the winter months. Wind speeds greater than 30 knots (Beaufort Force 7 winds, a near gale) occur 4.5% of the time during the winter months and only 0.1% of the time during the summer.

2.2 Waves

Typical wave height is 1.0 – 2.0 meters from the NW during winter, and 1.0 – 2.0 meters from the SE for the remainder of the year. The next table illustrates the percentage frequency of wave height greater than 2.0 and 4.0 meters. For the purposes of climate analysis: winter is defined as December, January, February; spring is March, April, May; summer is June, July, August; and autumn is September, October, November.

Table 2 – Percentage of Wave Height Greater than 2.0 and 4.0 Metres

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	58.1	12.5
Spring	28.2	3.1
Summer	13.8	0.4
Autumn	51.8	8.9

Waves larger than 2m pose a hazard to small craft.[3] Waves more than 4m pose a significant hazard to mariners, especially those close to shore and near ice floes where wave action can create confused seas. Waves over 4.0 meters are often associated with storms, which most mariners would consider unsafe boating conditions. An important factor to consider is the percentage frequency of abnormally high swell wave height, which can interact with other environmental factors in hazardous ways.

Ocean swell in SAR area 010 comes exclusively from the Southeast where it accumulates over the large span (fetch) of open water in the Atlantic Ocean and Labrador Sea. Throughout the year swell height is typically 0.0 to 1.0m. During inclement weather, swell wave height can increase in the 1.0 to 2.0m range. Swell greater than 4.0m is uncommon during the boating season with the exception of short-lived storm wave action.

[3] As reported by locals during arctic community engagement.

Table 3 – Percentage Frequency of Wave Height Greater than 2.0 and 4.0 Metres

Season	Frequency > 2.0m (%)	Frequency > 4.0m (%)
Winter	17.4	2.6
Spring	8.3	0.6
Summer	3.8	0.1
Autumn	13.3	1.0

When local wind waves and swell originate from reciprocal headings the result is a 'choppy' sea state characterized by shorter wavelength, steeper wave faces, and more spray. As the area's prevailing wind condition and swell direction are opposing, these adverse conditions exist in Davis Straight, Cumberland Sound, Frobisher Bay, and portions of the Hudson Straight.[4]

Swell characteristics are determined by distant weather systems in lower latitudes of the Atlantic Ocean. Low pressure systems tracking east through area 010 will result in moderate sea conditions arising in Foxe Basin and Hudson Straight. Low pressure systems tracking Northwest closely along the Labrador Coast can quickly create dangerous sea conditions in Area 010. As the air mass rotates counter clockwise around the low-pressure centre, wind waves combine with existing NW-moving swell to send gale-size waves towards Baffin Island.

[4] National Marine Weather Guide – Arctic Region

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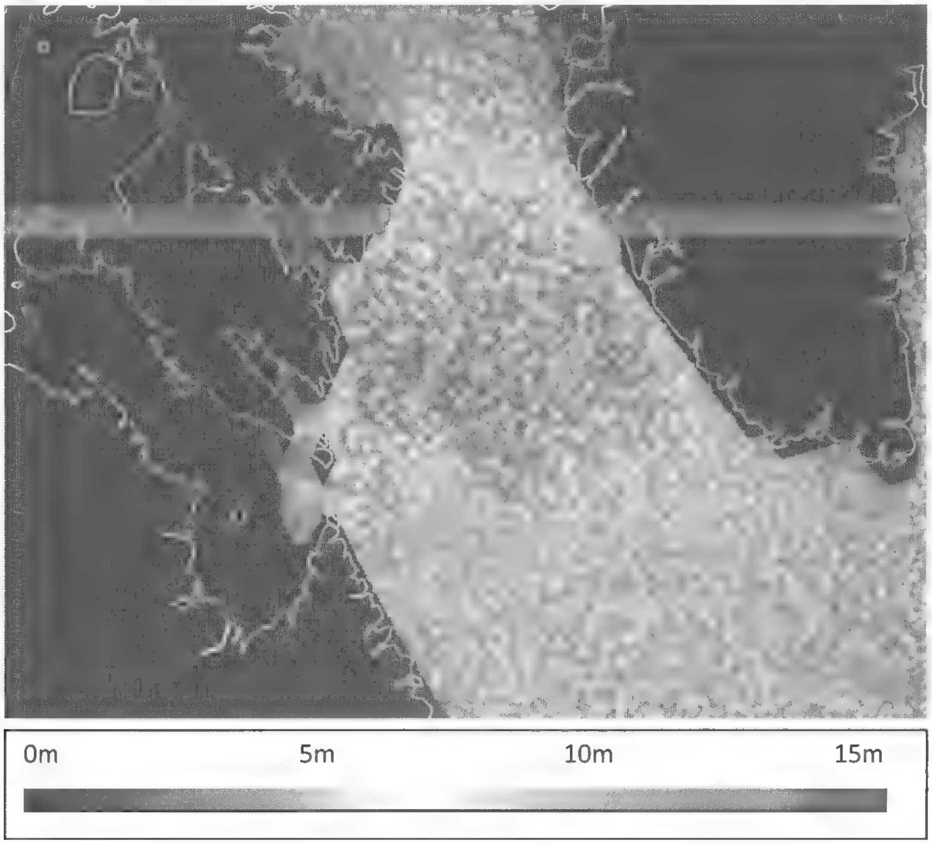

Figure 9 - Satellite Data from the National Oceanic and Atmospheric Administration captured 2018-10-27. Demonstrates the hazardous sea conditions which can occur in the Davis Straight, particularly along the Eastern shore of Baffin Island. The peak wave height recorded on this day was 11.81m.

2.3 Temperatures

2.3.1 Seasonal Air Temperature (°C)

Air temperature in Area 010 is closely linked with the albedo effect (the degree to which a surface reflects incident radiation or light) of snowpack & ice, daylight hours, and sea surface temperature. The climate of SAR Area 010 is defined as sub-polar in the Southern portion of Ungava Bay and polar for the remainder of the region according to the Köppen–Geiger climate classification system. Subpolar regions experience at least one month of mean temperatures above 10°C. Polar regions are classified as having mean monthly temperatures rise above 0°C for part of the year without exceeding 10°C.

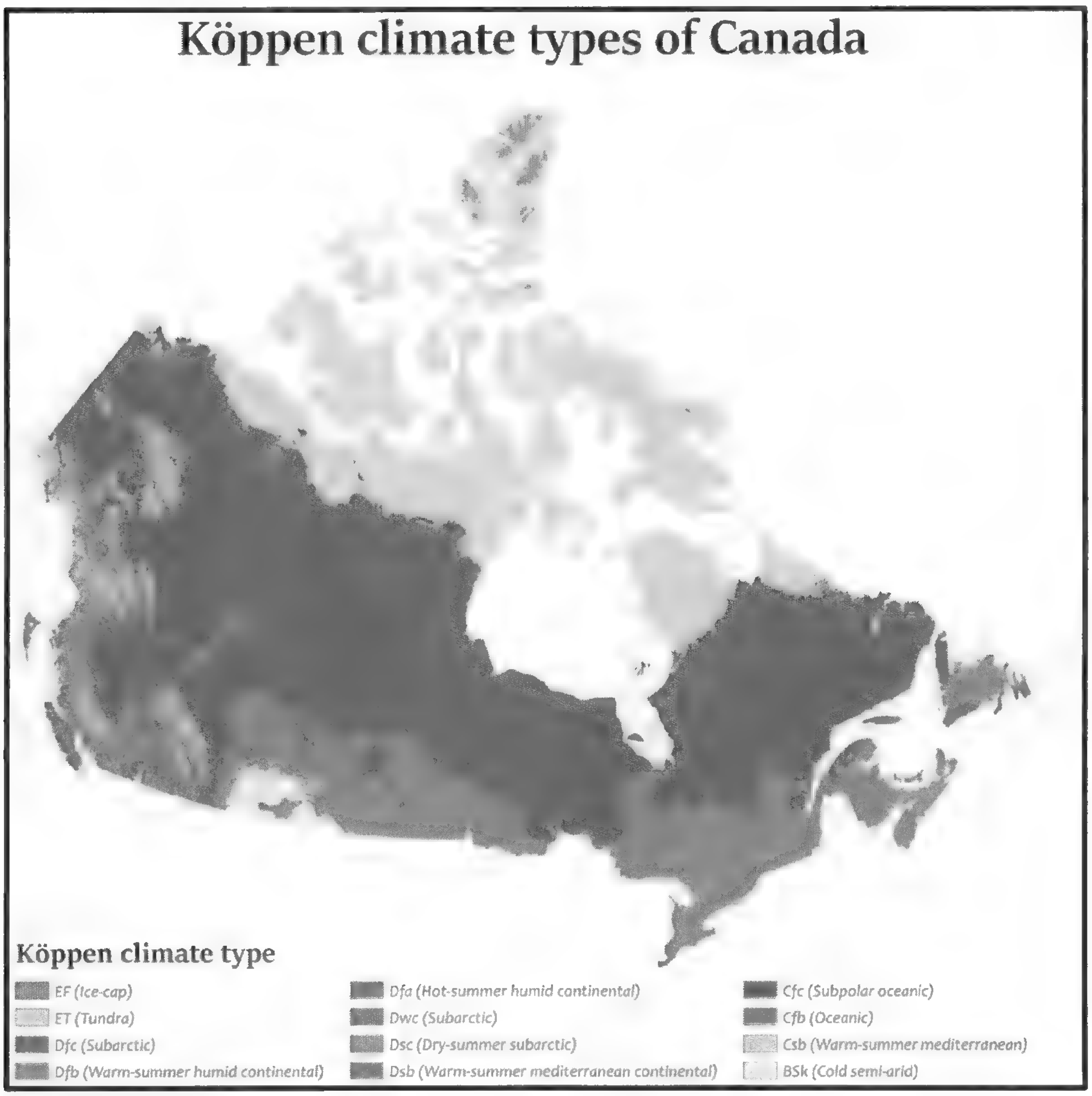

Figure 10 – Climate Types of Canada

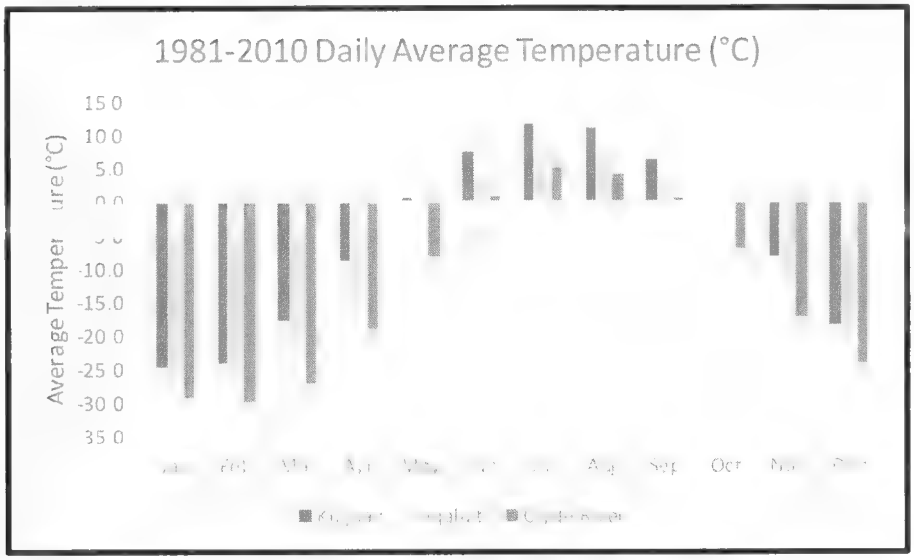

Figure 11 - Daily Average temperatures of Kuujjuaq (Southern), Iqaluit (Middle), and Clyde River (Upper) latitudes of SAR Area 010. This represents an aggregate of seasonal temperatures during the year. Note: Clyde River is not in SAR Area 010, it lies at 70° 28'N.

The seasonal variation of sea-surface temperatures in the Canadian Arctic during the active marine season shows a significant gradient (11°C annual temperature variation) in the South and little variation in the North (these waterways are ice-free for a shorter period of the year).[5]

2.3.2 Seasonal Sea Surface Temperatures (°C)

Season	Minimum	Maximum
Winter	-1.2	4.5
Spring	-0.7	5.0
Summer	-1.0	9.6
Autumn	-1.4	8.4

Figure 12 – Mean Seasonal Minimum and Maximum Sea Surface Temperature

[5] Data from Environment Canada using 30 year climate normals.

The Labrador Current is an important driver in regulating sea surface temperatures in all of area 010. Warm water travels north adjacent to Greenland, cools, then forms into the fast-moving (0.3 to 0.5 m/s) Labrador current. The flow is approximated to be 100km wide and 150m deep.[6]

The Labrador current acts as a barrier, preventing any warm water from entering Hudson Strait.

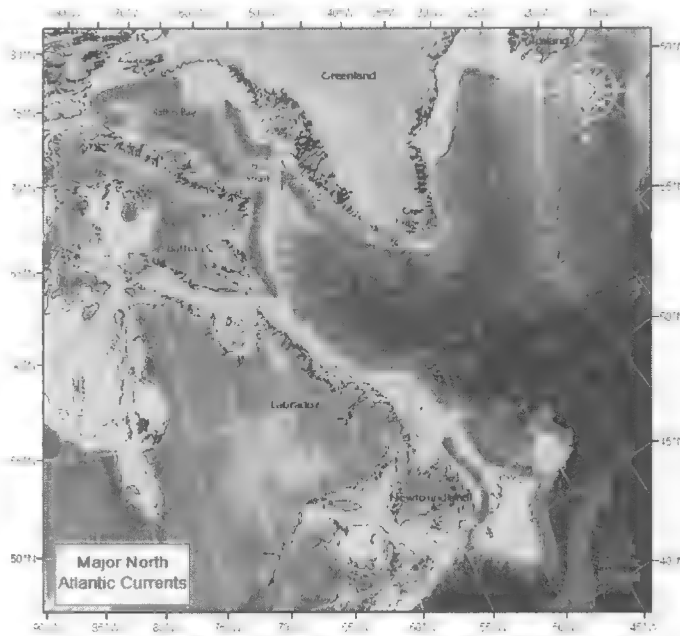

Figure 13 - North Atlantic Ocean Currents

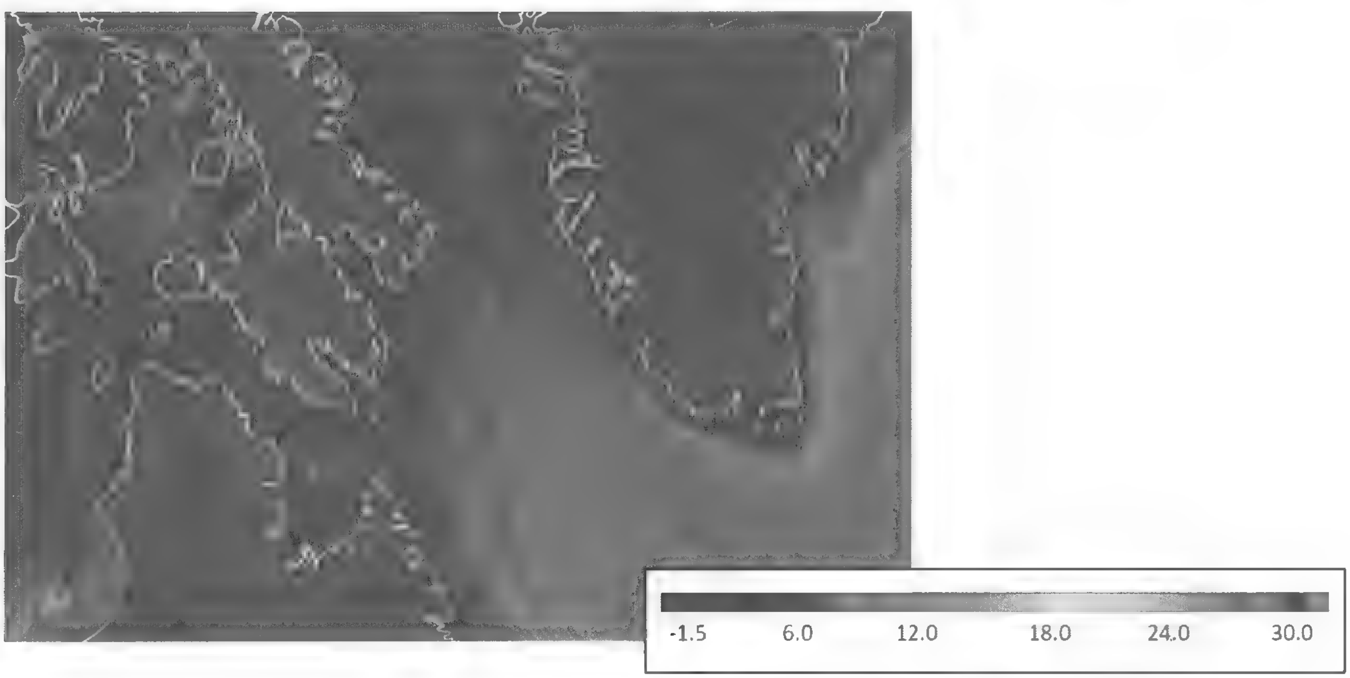

Figure 14 - Sea Surface Temperatures (°C) with Ocean Current Overlay on August 30, 2018

[6] USCG Northern Ice Patrol

2.4 Sea Ice

During a single winter in the Central and Western Arctic, maximum ice thickness is about 200 cm. Along the Labrador coast, the thickness of locally developed ice can reach about 120 cm.

SAR Area 010 is never entirely ice free during summer, with 2nd year ice and outflow from the Western and High Arctic providing a 30 year mean of %16 ice coverage during the months of July to October. Ice break-up dates are characterized by early shore fast ice dispersion near most communities with offshore ice lingering into July. Ungava Bay retains sea ice unusually late into the season in addition to experiencing an ingress of 2nd year Ice originating in Foxe Basin due to currents in Hudson Straight.

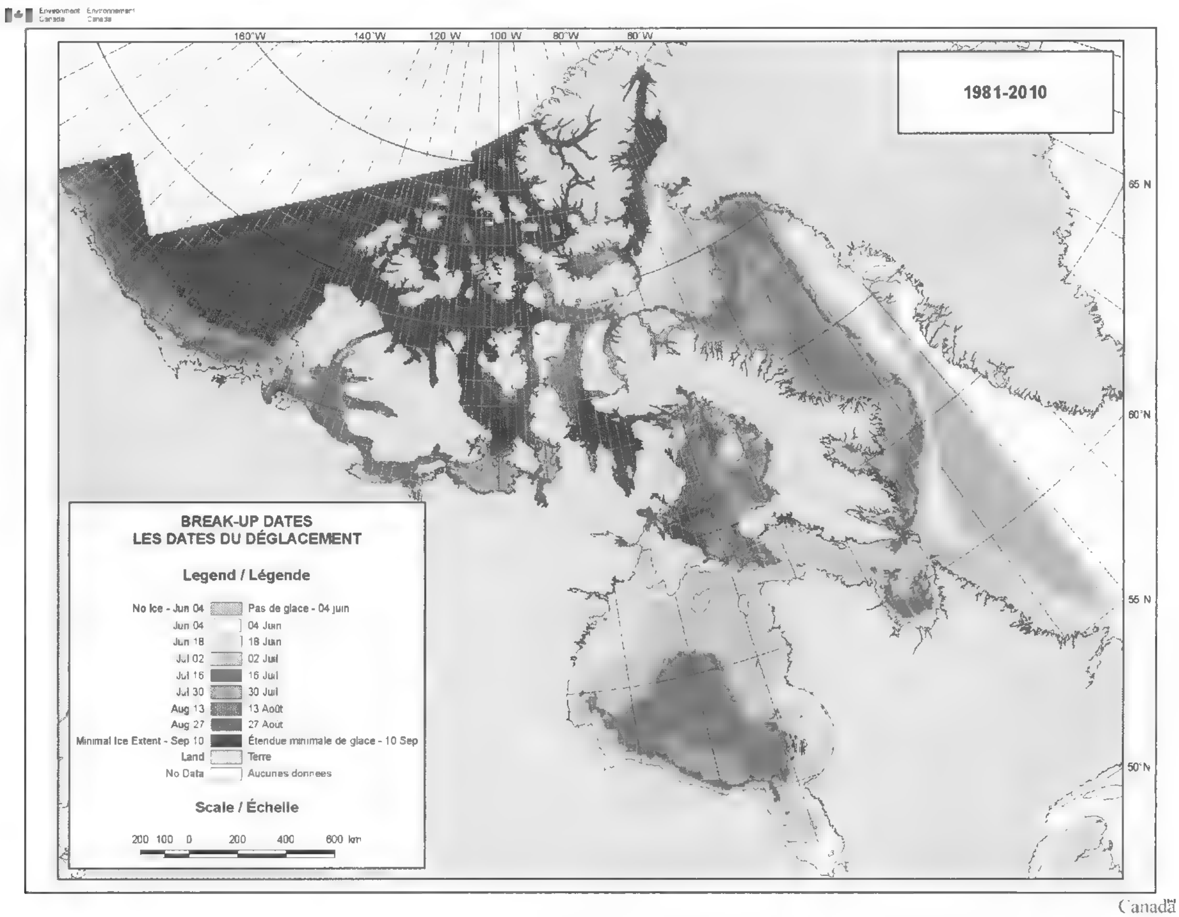

Figure 15 – Ice break up dates in SAR Area 010

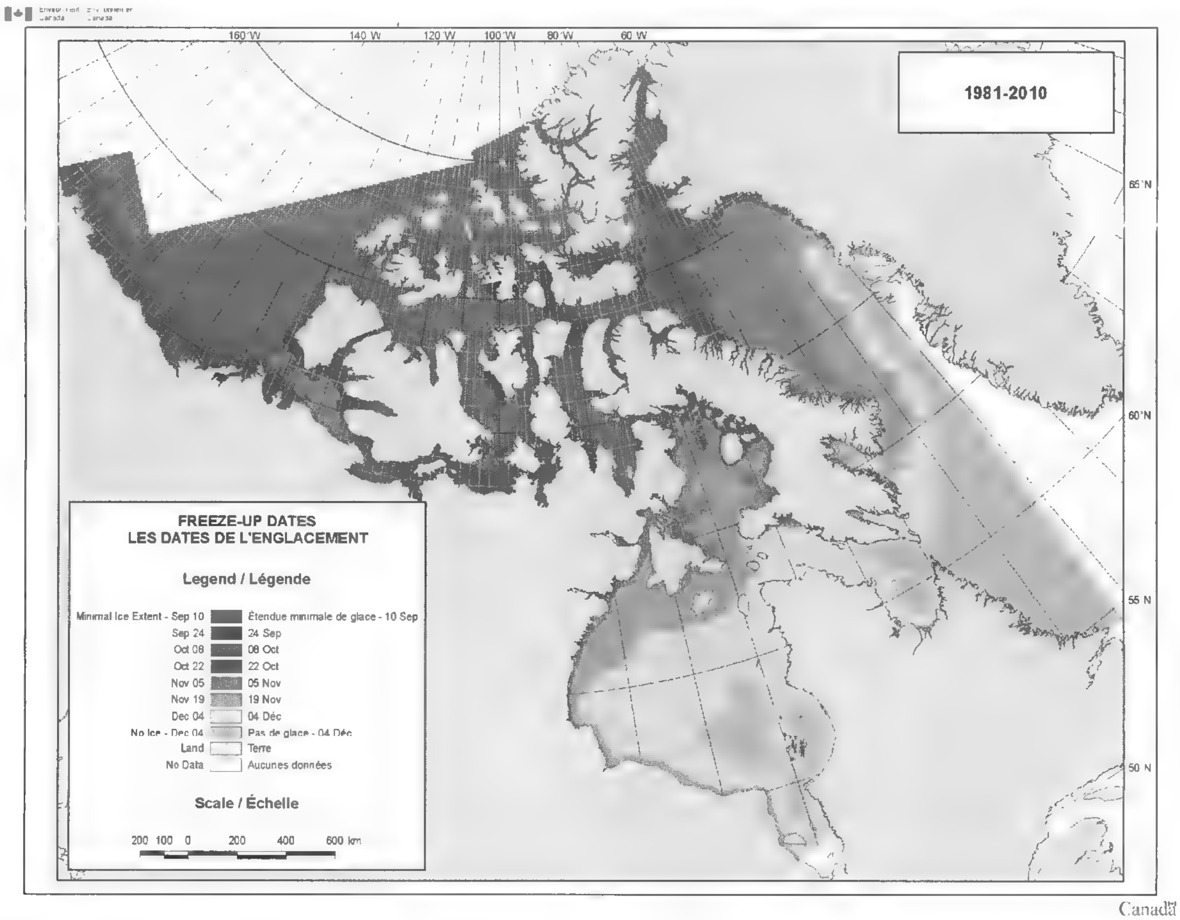

Figure 16 – Shore Fast Ice is the First to Arrive During the Winter Freeze Up.

2.4.1 Foxe Basin

Ice normally forms in Northern and Western portions near mid-October, thickening rapidly and spreading Southward and seaward to cover the Basin and Foxe Channel early in November. The ice becomes predominantly first-year ice by December.

Melting starts by June. The polynya near Hall Beach slowly enlarges. Open water leads expand around the shoreline in July. In the central Basin, the ice very gradually decreases in amount but more rapid disintegration occurs in August. Patches of ice persist during September.

In Foxe Basin shallow water combined with large tidal ranges and strong winds to keep a large amount of bottom sediments in suspension. Thus the ice is very rough, much of it in small floes and muddy in appearance. In Northern and Southwestern sectors there are large areas of shore-fast ice. In some years, all the ice will melt throughout Foxe Basin and Foxe Channel, while in other years with a cold summer, significant concentrations of ice will remain as freeze-up begins again. Second year ice may affect Foxe Basin and adjacent waters through the following winter and spring.

In Foxe Basin, freeze-up has started as early as late September and as late as the third week of October. Complete clearing does not occur every year but has occurred as early as the first week of September.

2.4.2 Hudson Strait and Ungava Bay

Freeze-up usually begins near the shore in Western Hudson strait in November, then ice formation progresses to cover the entire area by early December, and by mid-December the first-year stage predominates. Except for quite extensive shore-fast ice among the islands from Big Island to Cape Dorset, the ice is in constant motion because of strong currents and frequent gale force winds. Ridging, rafting and hummocking are continually taking place, and ice congestion often affects Ungava Bay and the South side of Hudson Strait. Conversely, a shore or flaw lead is frequently present on the North side of the Strait. At times small concentrations of second year ice drift into the area from Foxe Basin. Multi Year ice also enters Eastern portions from Davis Strait.

Open water leads develop in May and slowly expand in June. Clearing becomes extensive during July but Ungava Bay often remains encumbered with heavy deformed ice, with some embedded old ice in July. Complete clearing has taken place as early as mid-July and as late as the end of August. However, it is worth noting that incursions of second year ice from Foxe Channel occur in some years.

In Hudson Strait, freeze-up has started as early as mid-October and as late as the first week of December, while complete clearing has occurred as early as late July and as late as early September. Freeze-up in Ungava Bay has begun as early as late October and has been delayed until the second week of December.

2.4.3 Baffin Bay and Davis Strait

An open water route across Northern Baffin Bay has occurred as early as the third week of June and has been as late as the last week of August. Frobisher Bay has cleared of sea ice as early as late June and as late as early October. Baffin Bay and Davis Strait have cleared of all sea ice as early as mid-August, in other years some ice has remained until freeze-up began. In the latter situation the floes remaining are usually well dispersed throughout the area by autumn storms. Freeze-up in Northwestern Baffin Bay has developed as early as the last week of August and been delayed until the middle of October. In Frobisher Bay, new ice formation has begun as early as mid-October, and as late as the second week of November.

2.5 Tide & Current

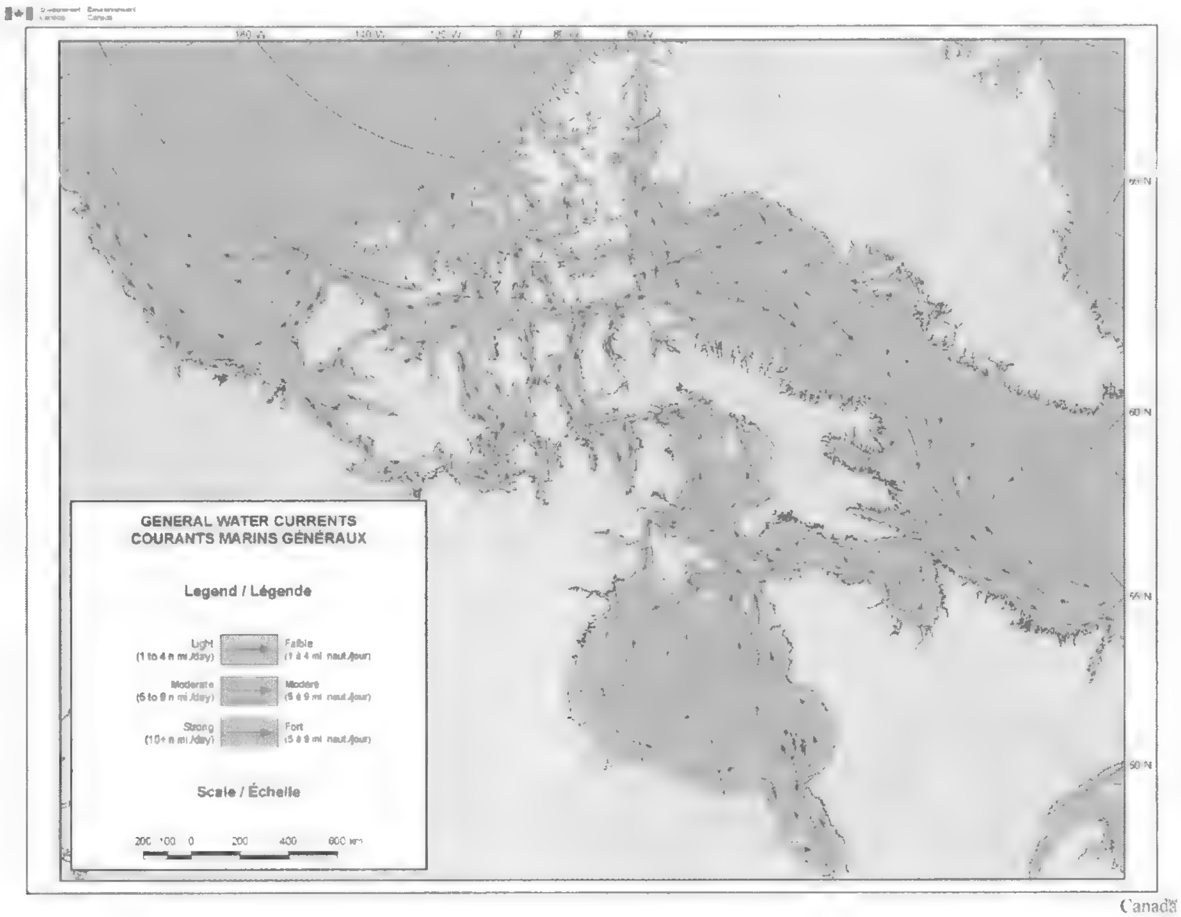

Figure 17 – Prominent currents in area 010 exist eastbound in Hudson Straight and Southbound in Davis Straight. Ungava Bay experiences a 'whirlpool' due to moderate currents in Hudson Straight. Currents are affected in the short term by significant tidal currents near to shore.

2.5.1 Hudson Straight

The tidal currents in Hudson Strait are strong, with progress more rapid along its Southern shore. Extreme tides can reach 8.4 m in Diana Bay and Quaqtaq. The strongest currents occur around the end of the Quaqtaq Peninsula. Strong spring tides also generate dangerous eddies along the shores.

A tidal current of 5 kts flows through the northeastern part of the strait between Resolution Island and Killiniq Island. Tides in Kimmirut reach 11 m in the summer months. Combined with strong currents, these racing tides often create rough seas near Kimmirut. The tidal range in Cape Dorset is 7 to 9 m.

2.5.2 Frobisher Bay

The tides in Frobisher Bay are the second most active in the world, the head of the bay experiencing a twice-daily tidal range with variations from 7 to 11m. Mariners must wait until high tide to get in or out of Iqaluit.

2.5.3 Ungava Bay

Ungava Bay has the second highest tides in the world, reaching up to 17 m at the head of the bay. [7]Navigation of the shallow waters along the West coast of the bay is hazardous due to the rapid rise and fall of the tide with its associated strong current. The maximum tidal range is approximately 5 m at the Button Islands, almost 11 m at Hopes Advance Bay, 11 to 12 m at Koksoak River, and 15 to 17 m in Leaf Bay, which is known for its swift and dangerous tidal currents. Tidal currents in McLelan Strait, between the mainland tip of Labrador and Killiniq Island, can reach 10 kts during spring tide.

The tides in Kangirsuk are known to reach a maximum of 10 m. This, combined with the large rocks in the bay, can create chaotic ice conditions. Kuujjuaq spring tidal currents, with a range of 11 to 12 m, can reach 12 kts with the outgoing tide, creating many whirlpools in the area.

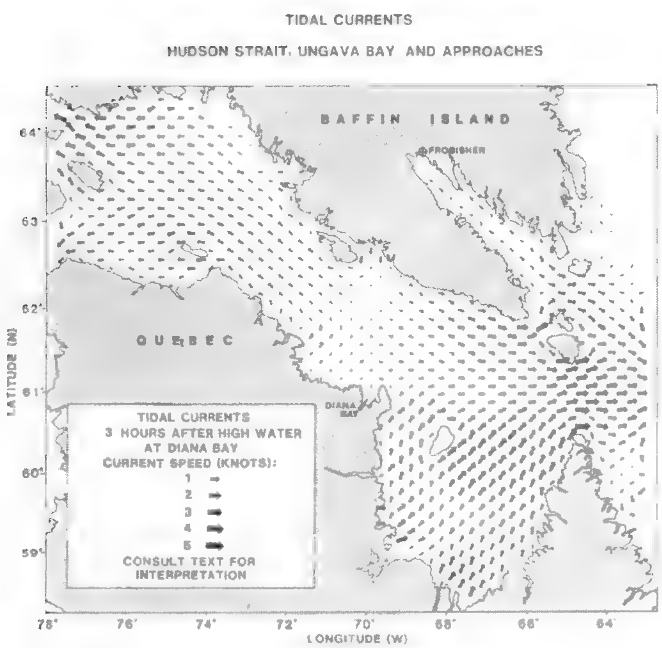

Figure 18 - Tidal Currents at Maximum EBB Current

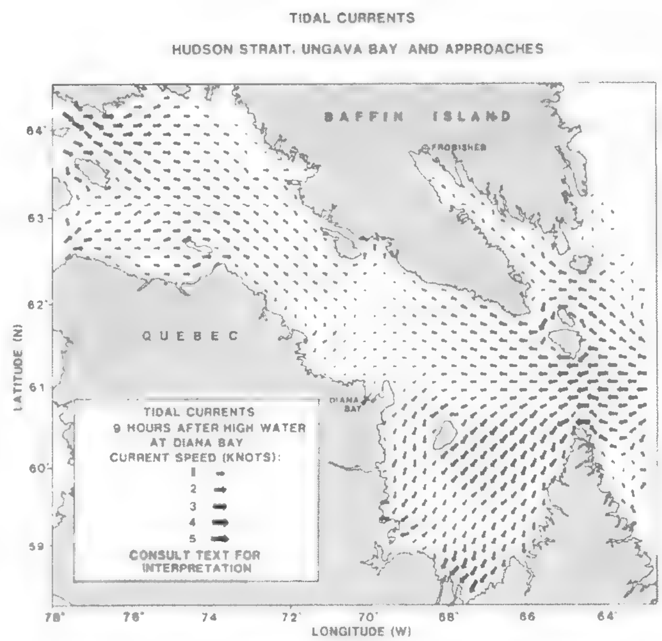

Figure 19 - Tidal Currents at Maximum Flood Current

[7] Canadian Hydrographic Survey, 1986.

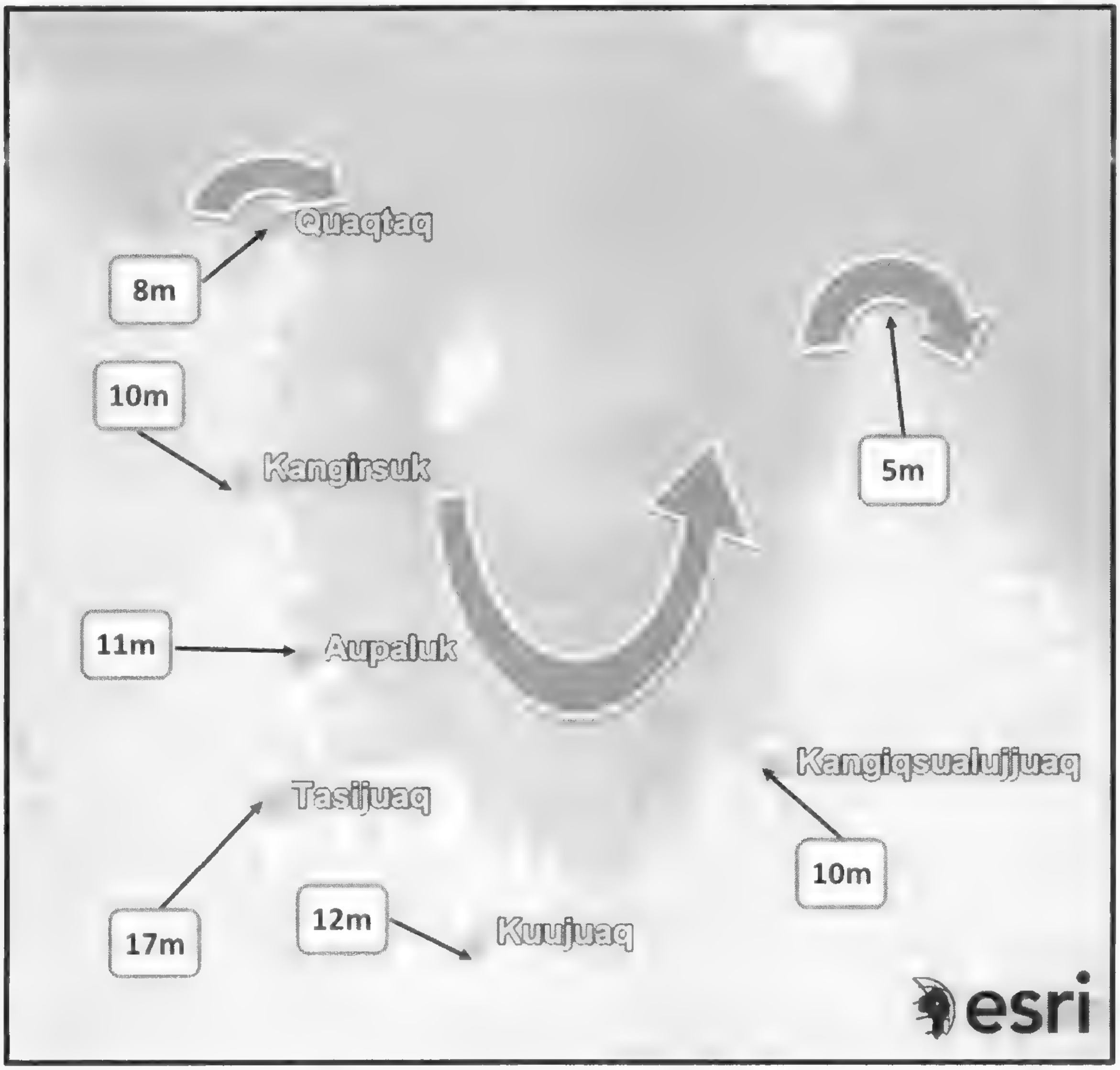

Figure 20 – Current in Ungava Bay. Values represent tidal variation in meters

2.5.4 Davis Straight

The tides in Qikiqtarjuaq Harbor experience a modest rise and fall. The maximum speed of the tidal stream in Broughton Channel is approximately 1 kt.

2.5.5 Cumberland Sound

The peak tidal range in Cumberland Sound is 5m. There are strong tidal streams around Miliakdjuin Island and Nettilling Fiord and many violent eddies and tide rips along the route from Pangnirtung Fiord to Clearwater Fiord. Strong currents off Cape Mercy cause turbulence at the Northern entrance to Cumberland Sound. Due to the large tides experienced in the Pangnirtung region, boats can only arrive and depart the harbor within two hours on either side of high tide, which occurs twice every 24 hours. Tidal streams are around 2 kt.

2.6 Effects of Climate Change

2.6.1 Ice Season

The most noticeable impact of climate change in area 010 is the characteristics of sea ice. Given a linear growth in the ice-free dates from figure 10, communities such as Cape Dorset, Kimmirut, Kuujjuaq, and Kangiqsualujjuaq will soon begin to see ice-free conditions year-round. Such phenomena would alter the harvesting routines of local Inuit populations, where ice fishing could be replaced by fishing from a vessel if it proved more advantageous.

2.6.2 Population

In general, a longer ice-free season for arctic communities equates to more opportunity for merchant sealifts, mineral shipment, fishing (commercial and subsistence), cruise ship activity, research vessels, and merchant tankers to service communities and businesses. This gives rise for new jobs and subsequently new residents to arctic communities. In addition, Canadian Inuit currently have a high birth rate[8], with family size growing quickly in most communities. Coupled with economic growth, such activity will increase demand on the SAR resources operated by the Canadian Coast Guard in area 010.

2.6.3 Micro-Climates

Kuujjuaq and Kangiqsualujjuaq are both situated on lee shores with the prospect of open water developing near shore in the winter months as the climate of the region changes. Water can become no colder than -1.6°C before undergoing phase change to ice. As cold arctic air masses pass over the relatively warm span of open water from the NW, such air masses will be warmed and subsequently absorb moisture. Such phenomenon is called 'arctic sea smoke' when open water meets frigid air temperatures and creates localized precipitation. This arrangement will significantly alter the climate of these communities, resulting in milder winters with more precipitation along the West side of the Torngat Mountains. Fog would become more prevalent near shore as moisture-laden air passes over cool land and precipitates.

[8] 2016 Census

2.6.4 Precipitation & Winds

Further meteorological study is required to accurately assess the future of precipitation and wind in SAR area 010.

2.7 Main Findings for Navigational Risk in SAR Area 010

2.7.1 Swell vs Local Wind & Current: Choppy seas on East Coast of Baffin Island

Prevailing wind in SAR area 010 is from the NW. Current in the area travels east (Hudson Strait) and then south (Labrador Current). Prevailing swell arrives from the SE. The reason for this reciprocity is North Atlantic high pressure systems combining with low pressure formations over Canada. The result is moderate-sized (1.0 – 2.0m) swell accumulating over the fetch length from Newfoundland to Baffin Island.

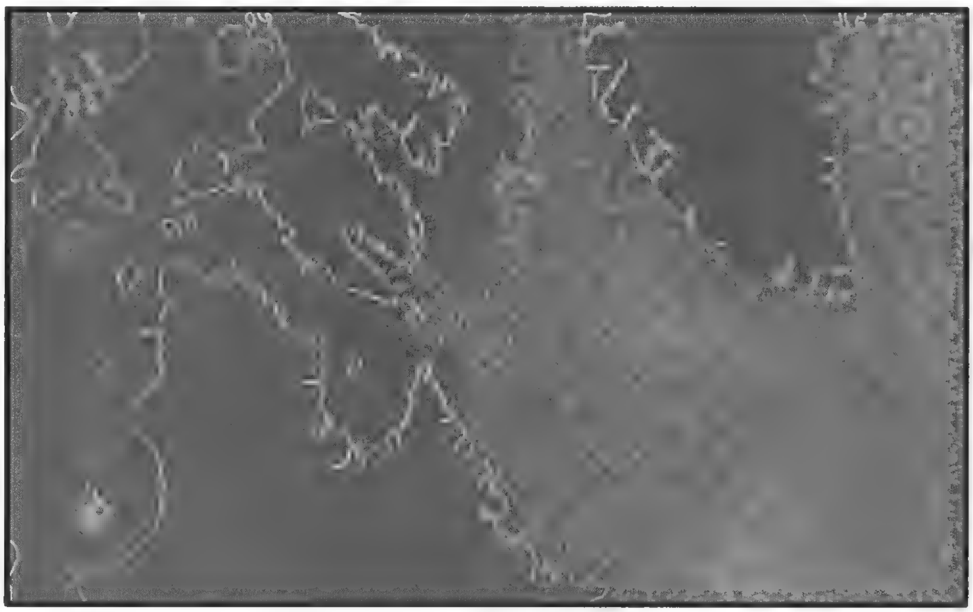

Figure 21 – Swell Direction and Height (1.0 – 2.0m) on June 29, 2018.

When these three forces combine, the result is a confused "choppy" sea with larger wave height, more spray, and steep wave faces.

Local winds blowing out of Cumberland Sound, Frobisher Bay, and Hudson Strait interact with the swell by creating wavelets moving in the opposite direction of the swell at the mouths of these three bodies of water.

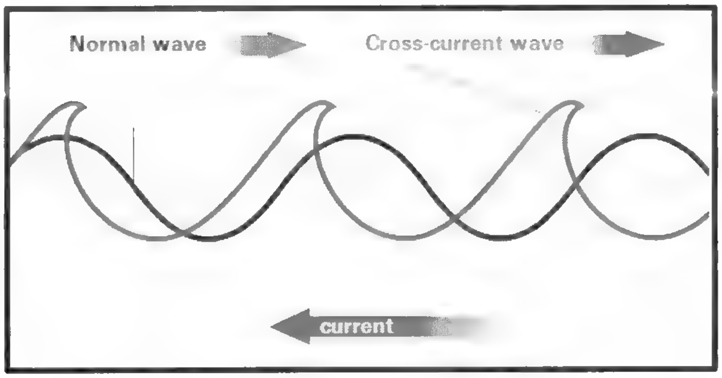

Figure 22 - Wave Characteristics in Swell vs. Wind Conditions

This phenomenon is hazardous at the entrance of Cumberland Sound (Pangnirtung) and Frobisher Bay (Iqaluit), where local winds funnel from the NW and collide with swell alongside the Labrador Current. This becomes problematic as conditions for entering and departing the communities of Pangnirtung and Iqaluit to open ocean remain adverse for most of the boating season. Similarly, potential exists for adverse conditions to develop in the Hudson Straight north of the Torngat mountain range where the straight meets the Labrador Sea.

For local vessels; thoughtful preparation, training, and equipment can only be seen as the first step for any trip on the water. In situations where transiting choppy conditions are essential, an enclosed-cabin vessel is a much safer alternative to protect boaters from the elements.

Figure 23 - SAR area 010 hazardous sea area. Cargo vessel routes in purple, cruise ships routes in green. Width of line is proportional to traffic level.[9]

2.7.2 Sea Ice Accumulation: Ungava Bay Affected by 2nd year Ice from Foxe Basin

Current in the Hudson Straight flows east. Each season, sections of 2nd year Ice from Foxe Basin float down the straight. Due to the shape of Ungave bay, ice and current are diverted into the bay and rotate clockwise along the shoreline. The result is that old, thick ice remains near to shore much later into the summer (mid-August). As shore fast ice fractures and gives way to open water near shore - mariners attempting to access the open water beyond must navigate through an ever-changing, substantially old, field of ice.

[9] Small craft routes as reported by communities during RAMSARD engagement trip (Jan/Feb 2019)

3. Maritime Geography

3.1 Coastal Features

SAR Area 010 contains numerous inlets, fjords, and river mouths. At present, less than 10% of Arctic waters are surveyed to modern standards.[10]

3.1.1 Cumberland Sound

Cumberland Sound is a 130nm long inlet extending into Baffin Island off Davis Straight. It is characterized by several fjords on the NE shore, one of which is host to the community of Pangnirtung. The peak tidal range is 5m. This affects navigation close to shore as countless shoals become exposed. Tidal currents are also strongest near the shore. The Southern shoreline of Cumberland sound has numerous shoals and islands which are characteristic of a Canadian Shield coastline.

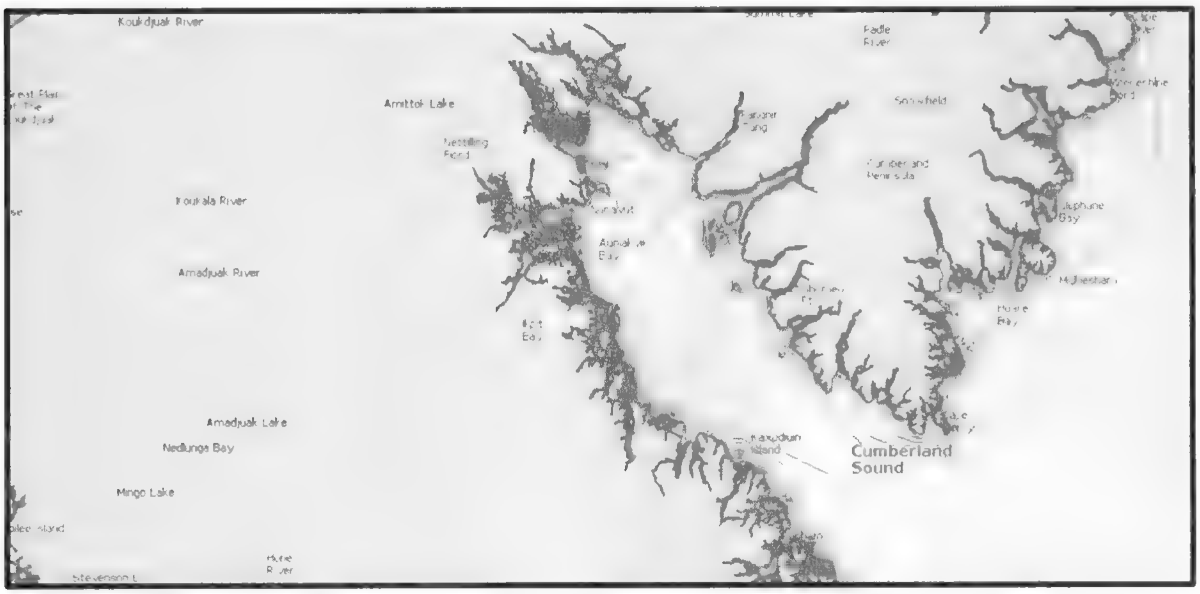

Figure 24 – Cumberland Sound (Navionics).

[10] As reported by the Canadian Hydrographic Survey.

3.1.2 Frobisher Bay

Frobisher Bay is a 140nm long inlet extending into Baffin Island. It is characterized by its long, narrow shape which gives rise to substantial tidal ranges. Most islands in the bay are long and narrow, running parallel to the direction of the bay (NW to SE). This means that there is little relief from tidal currents as island provide little shelter. The same is true for winds, which are typically from the NW. The peak tidal range is 11m. This affects navigation close to shore as countless shoals become exposed. Tidal currents are also strongest near the shore.

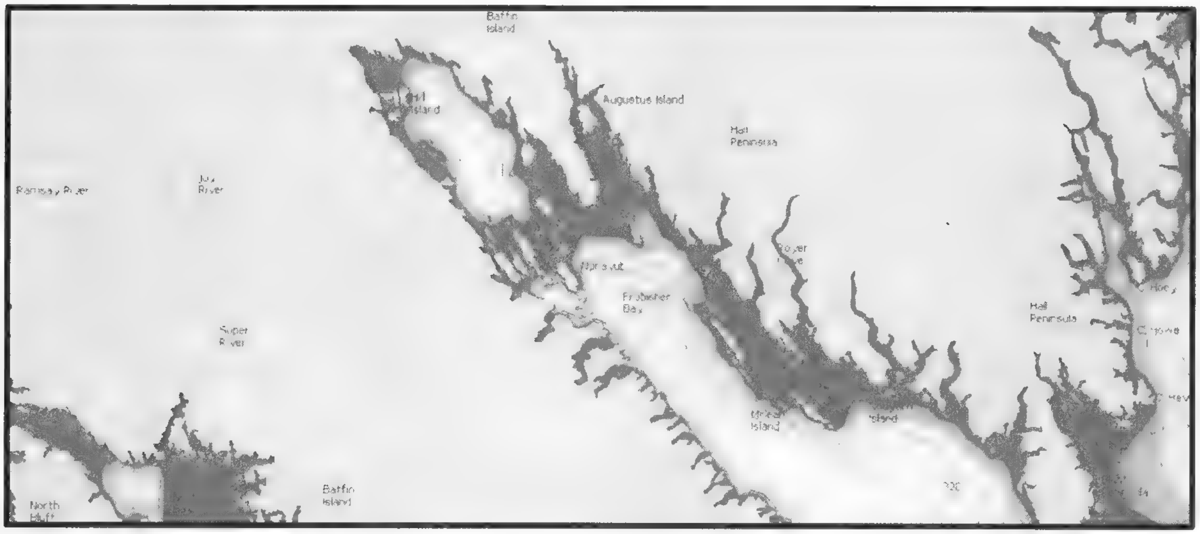

Figure 25 – Frobisher Bay is home to Iqaluit and some of the world highest tides (Navionics).

3.1.3 Hudson Strait

West Hudson Strait lies at the confluence of Foxe Basin and Hudson Bay. It is characterized by its moderate West to East currents which transport ice floes out of the arctic toward the Labrador Sea. Its bathymetry is deep and navigable - save for the ice activity. Dorset Island, on the North side of the straight, is home to Cape Dorset and a bustling Inuit population which harvest along the rocky coastline of Baffin Island and beyond. Tides in Cape Dorset can reach 9m. Currents are strongest along the southern shore of the straight, reaching up to 9nm per day. The north shore typically sees movement less than 5nm/day, sometimes backing.

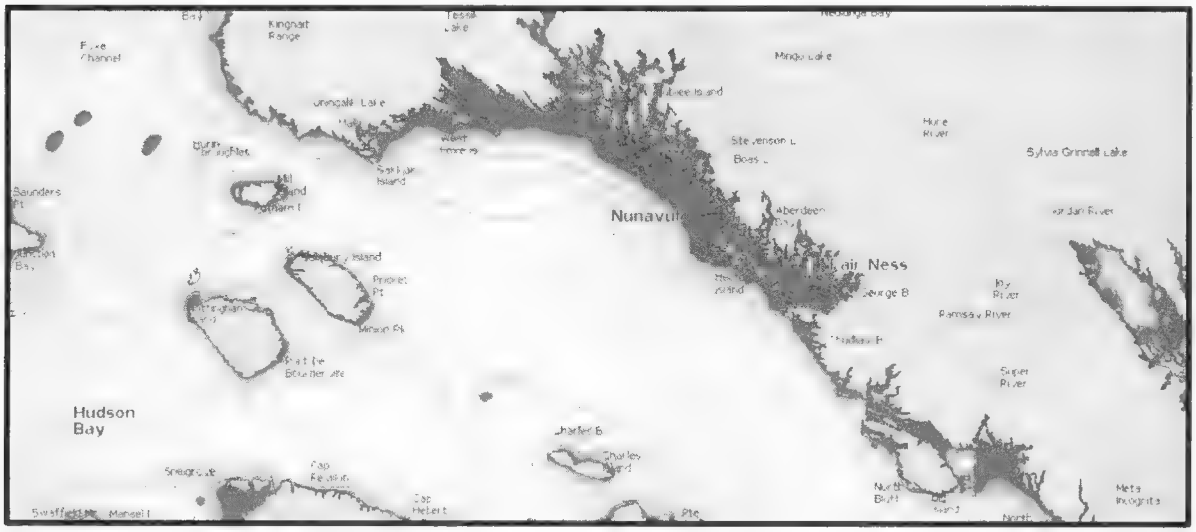

Figure 26 – West Hudson Straight is a Highway for Ice Floes During the Summer Break-Up.

The Eastern Hudson Straight lies at the confluence of Ungava Bay and Davis Straight. It is characterized by its moderate to strong W → E currents which transport ice floes out of the arctic toward the Labrador Sea. Its bathymetry is deep and navigable - save for the ice activity. Resolution Island narrows the exit of the straight, which leads to stronger currents, ice congestion, and choppier sea. Current is also known to be particularly strong at the NW corner of Ungava Bay (Diana Bay), and the Button Islands as it wraps around these points of land. Tides in Kimmirut are known to reach 11m. Currents are strong along the southern shore of the straight, reaching up to 9nm per day. In addition, a slow-moving whirlpool exists in Ungava Bay which retains ice late into the season.

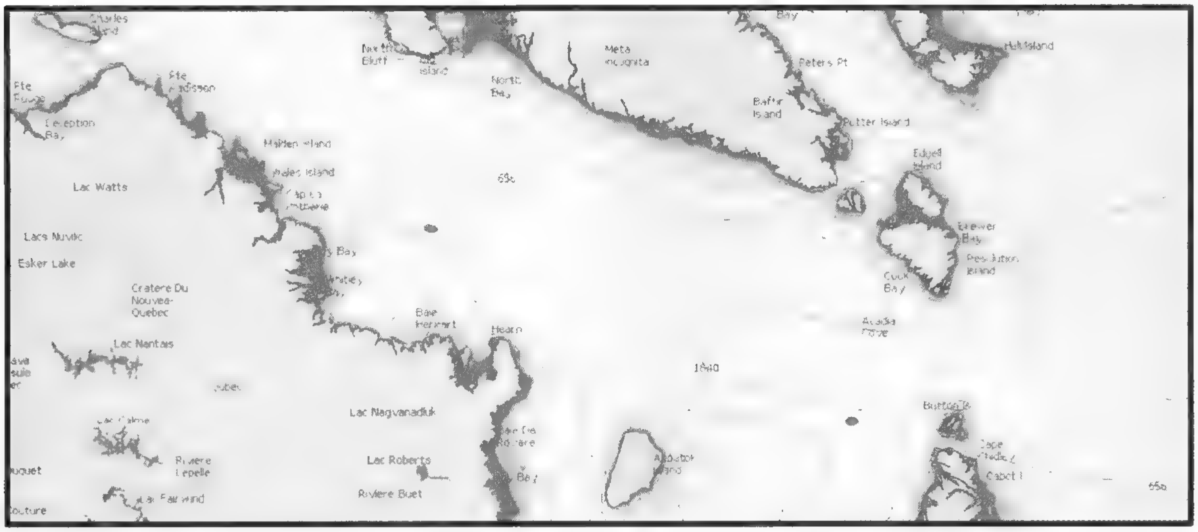

Figure 27 – East Hudson Straight is One of the Busiest Shipping Areas of the Canadian Arctic.

3.1.4 Ungava Bay

Ungava Bay is a large inlet in the Nunavik region of Quebec. It is characterized by gently sloping bathymetry with communities situated in brackish river water. Ungava experiences enormous tides, ranging from 8m at the mouth of the bay to 17m in the Koksoak River further afield. Currents are particularly hazardous on the East shore of the bay, where harsh, rocky topography from the Torngat Mountains extends into the bay. A slow-moving whirlpool exists in Ungava Bay which retains ice late into the season. Ice remains south of Akpatok Island longest due to tidal eddies retaining ice floes.

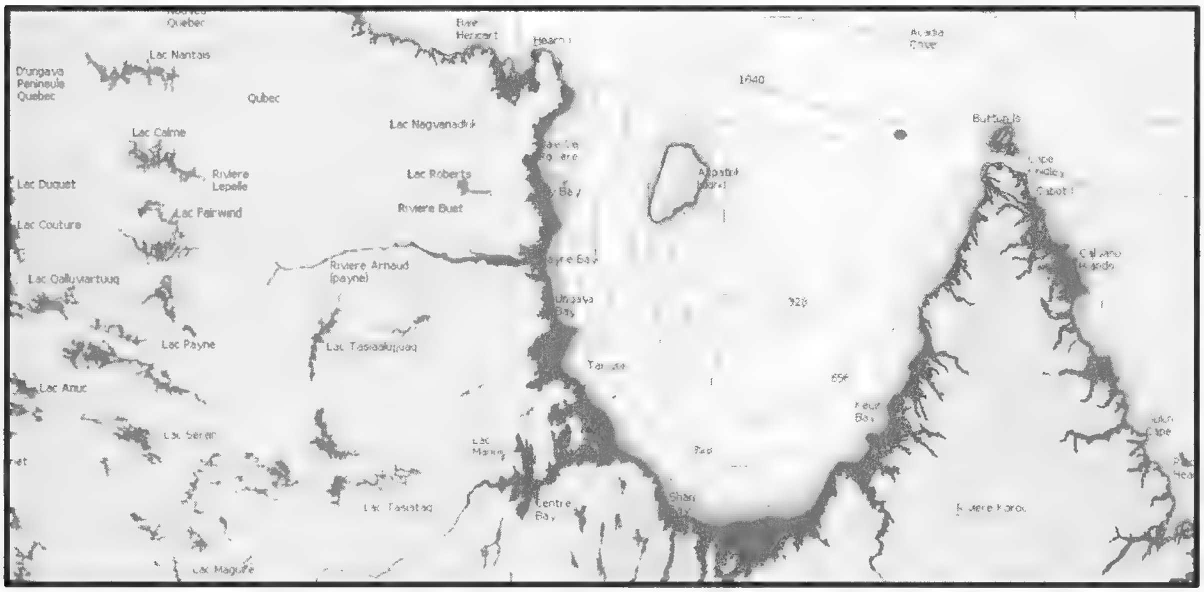

Figure 28 – Ungava Bay is Dotted with Communities Along its Rugged Shoreline.

3.1.5 Foxe Basin

Foxe Basin is a body of water in the Arctic Archipelago West of Baffin Island. It is characterized by a shallow, muddy bottom and complex navigation. Foxe Basin's shallow depth allows the body of water to freeze sooner than other basins at similar latitude. The basin lies partially in the Canadian Shield – notably it's South, North, and Western shores. Prince Charles Island and the Eastern Shoreline have a much higher sediment concentration which lends itself to fewer small islands, gently sloping bathymetry, and uniform shorelines.

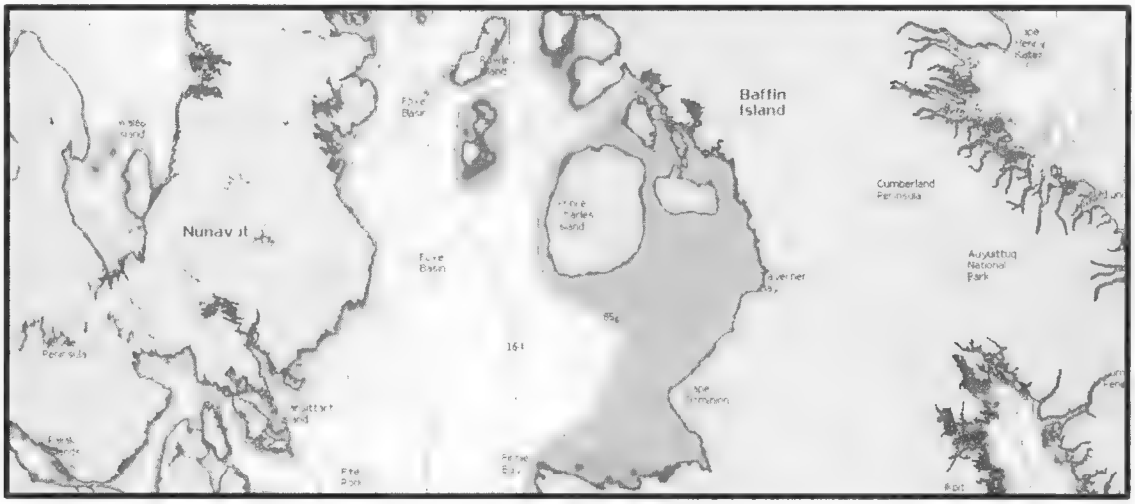

Figure 29 – Bathymetry of Foxe Basin leads to a very active ice environment. Ice from the eastern side of the basin is known to be muddy in appearance, due to ice floes dragging large portions of ice against the bottom surface.

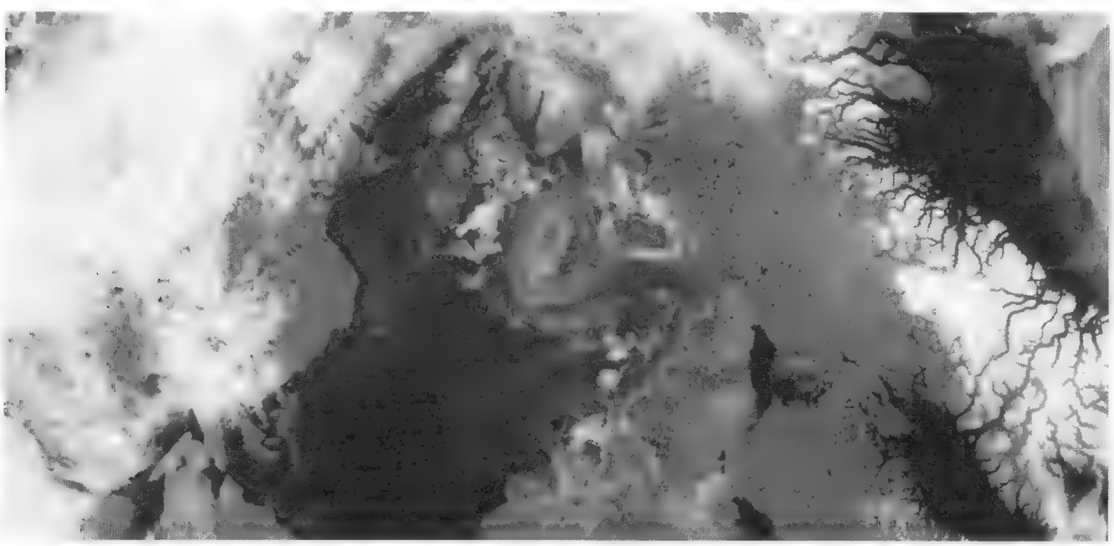

Figure 30 - For a better appreciation of Foxe Basin, one must view it from satellite imagery. Taken 04-09-2018, Foxe Basin on a sunny day reveals residual ice floes which did not melt during the summer, making navigation at any time of the year hazardous without the appropriate ice-class rating. The shallow bathymetry of Eastern Foxe Basin is evident in the turquoise coloration of the water.

Most of the shoreline in Area 010 is comprised of exposed rock islands, shoals, coastal cliffs, fjords, and glacial sediment (sand & gravel) due to the Canadian Shield. This geology provides countless natural harbors and safe havens. Unmarked shoals, strong near-shore currents, and enormous tidal ranges make seeking refuge near shore hazardous to those without local knowledge of the area.

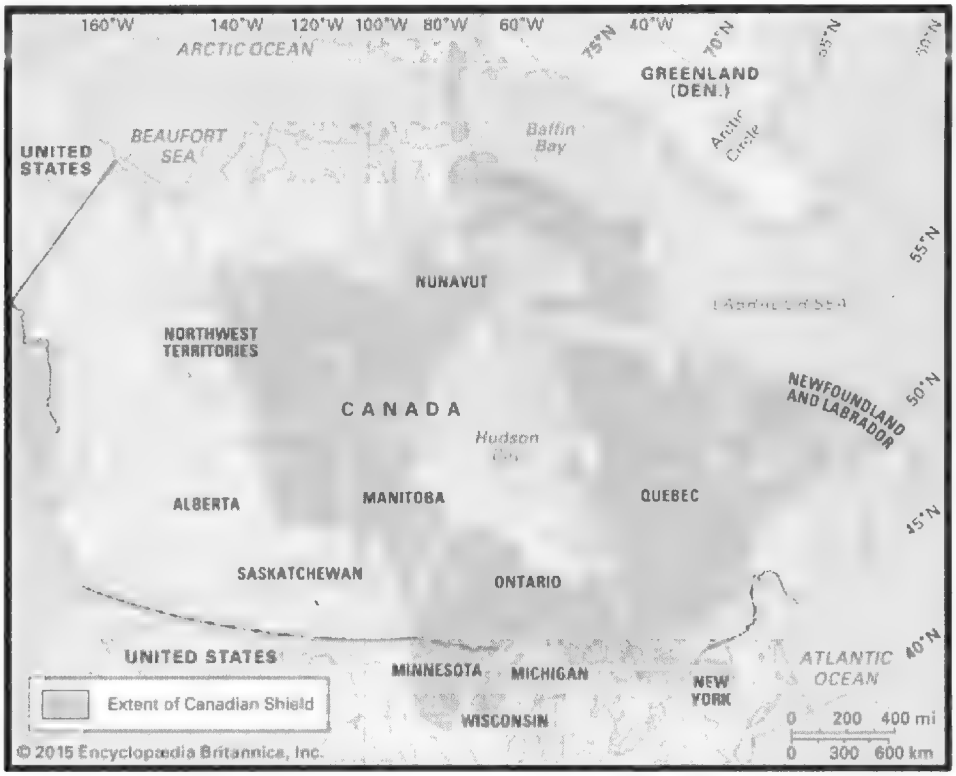

Figure 31 – The Canadian Shield covers much of area 010. This span of geography contains a thin layer of soil (if any) atop large rocky outcrops which often present themselves as islands near shore.

3.2 Oceanographic Features

SAR area 010 contains a portion of the Labrador shelf where it meets the Labrador Basin/ Davis Straight. It is here where depths change from hundreds to thousands of meters. Hudson and Davis Straight range from 300 to 900m in depth. Foxe Basin is typically 20m deep. The Labrador Sea drops to below 3000m.

The Labrador Shelf approximates the extent of ice coverage in the height of winter. When ice-free, the bathymetry gives rise to adverse sea conditions when storms track NW along the Labrador Coast. Fishing in the Arctic occurs in waters less than 1000m deep.

Figure 32 – Darker blue coloration represents deep water. Note the disparity between the 20mdeep Foxe Basin, the surrounding straights, and the Labrador Sea.

4. Demographics

4.1 Coastal Population Centres

The regional population is 16,108.[11] Iqaluit (population 7,740) is the administrative hub and capital city of Nunavut while Kuujjuaq (population 2,754) is the largest of the Nunavik communities in Northern Quebec.

Figure 33 - SAR Area 010 Communities

The National Pleasure Craft Operator Competency Program reported 472 individuals hold a Pleasure Craft Operator's Card (PCOC) in Nunavut as of 2018-11-08. Proof of competency is not required for mariners in NWT and Nunavut, nor is it required for Inuit and First Nations engaging in subsistence activities, such as fishing.

The Competency of Operators of Pleasure Craft Regulation states:

"(1) These Regulations apply in respect of pleasure craft that are fitted with a motor and that are operated for recreational purposes in Canadian waters, other than the waters of the Northwest Territories and Nunavut. (2) These Regulations do not apply in respect of seaplanes."

[11] 2011 Census

Seasonal population variance is of note in Nunavut. SAR area 010 becomes busier during the summer months. 13 offshore fishing vessels return to Davis Strait each year, most with a crew of about 30. 11 fuel tankers and 8 merchant cargo vessels with average crew size of 20 begin servicing communities in July and continue through until October. In addition, up to 10 cruise ships enter NORDREG each season with passenger lists from 12 (Hanse Explorer) to 1622 (Crystal Serenity) people on board. Flights to and from Iqaluit spike in August each year.

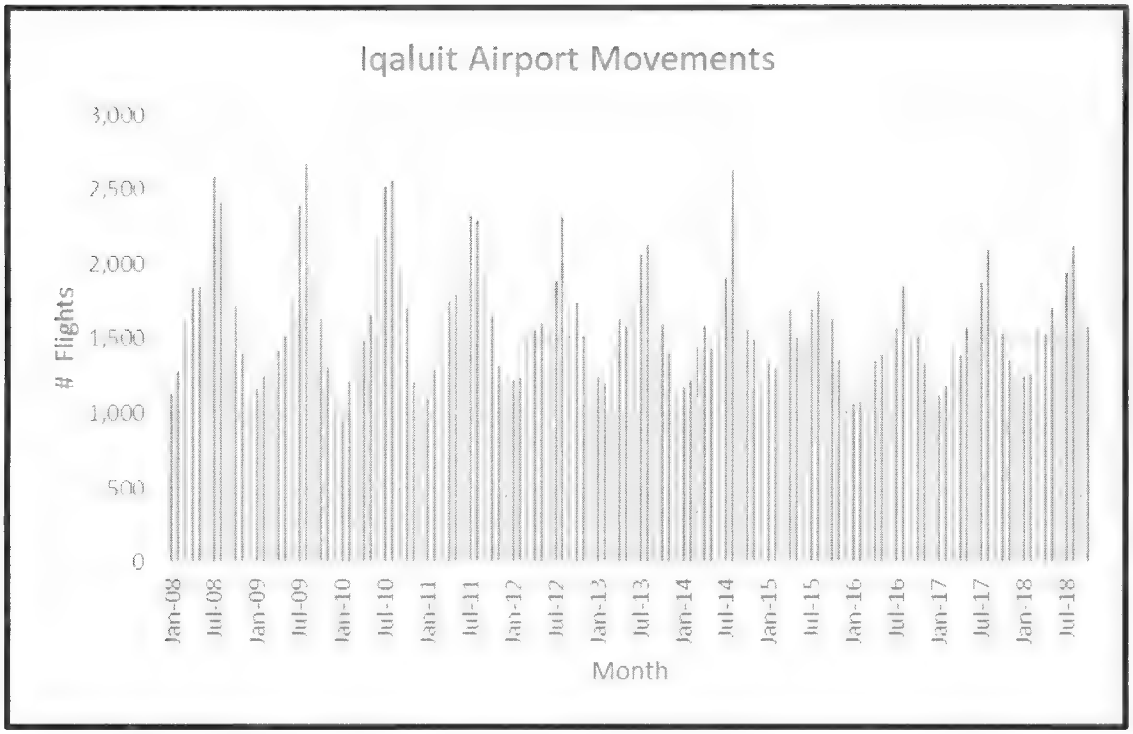

Figure 34 – 10 year Trend for Monthly Flight Movements in Iqaluit

4.1.1 Kangirsuk

Table 4 – Kangirsuk Details

Population	567	
Location	Latitude: 60° 1' 6.7" (60.0185°) north Longitude: 70° 1' 34.5" (70.0263°) west Elevation: 15 meters (49 feet)	
Description	Kangirsuk, meaning 'the bay' in Inuktitut, is located on the north shore of the Payne River, 13 km inland from Ungava Bay. The village lies between a rocky cliff to the north and a large, rocky hill to the west. It is situated about 118 km south of Quaqtaq and 230 km north of Kuujjuaq. The numerous lakes and rivers of the area are well-known for their arctic char and lake trout. The strong tides that occur on the Payne River make it an extraordinary place for mussel harvesting. Akpatok Island to the east, is considered a local attraction for viewing its resident polar bears.	
Average Annual Commercial Marine Activity	Merchant General	4-6
	Merchant (Tanker)	1 (2 arrived in 2014)
	Merchant Passenger	0
	Other	4 RO/RO Vessels in 2013

Figure 35 – Spring in Kangirsuk.

4.1.2 Aupaluk

Table 5 – Aupaluk Details

Population	209	
Location	Latitude: 59° 18' 1.5" (59.3004°) north Longitude: 69° 35' 54.7" (69.5985°) west Elevation: 33 meters (108 feet)	
Description	Aupaluk, the smallest Nunavik community, is located on the southern shore of Hopes Advance Bay, an inlet on the western shore of Ungava Bay. It is about 150 km north of Kuujjuaq and 80 km south of Kangirsuk. The village is built on the lowest of a series of natural terraces about 45 m above sea level. Aupaluk has a small harbor which can be used at high tide. A small wharf platform extends from the break wall.	
Typical Commercial Marine Activity	Merchant General	5-7
	Merchant (Tanker)	1
	Merchant Passenger	0
	Other	1 Roll-on/Roll-off (RO/RO) in 2012 and 2013

Figure 36 - Aupaluk (Mario Faubert)

4.1.3 Tasiujaq

Table 6 – Tasiujaq Details

Population	369	
Location	Latitude: 58° 41' 45.4" (58.6959°) north Longitude: 69° 55' 39.5" (69.9276°) west Elevation: 6 meters (20 feet)	
Description	Tasiujaq was built on the shores of Leaf Lake at the head of Deep Harbour. It lies a few kilometers north of the tree line. Here, the shrub tundra finally gives way to the arctic tundra. Tasiujaq, which means 'resembling a lake,' actually refers to the whole of Leaf Basin: Leaf Lake, Leaf Passage and Leaf Bay. Leaf Basin is renowned for its high tides which regularly exceed 15 m. Inuktitut is the majority spoken language. Tasiujaq has a small boat launch area which offers limited protection from tidal currents.	
Typical Commercial Marine Activity	Merchant General	3-5
	Merchant (Tanker)	1
	Merchant Passenger	0
	Other	RO/RO 1 vessel in 2012, 2013, 2016

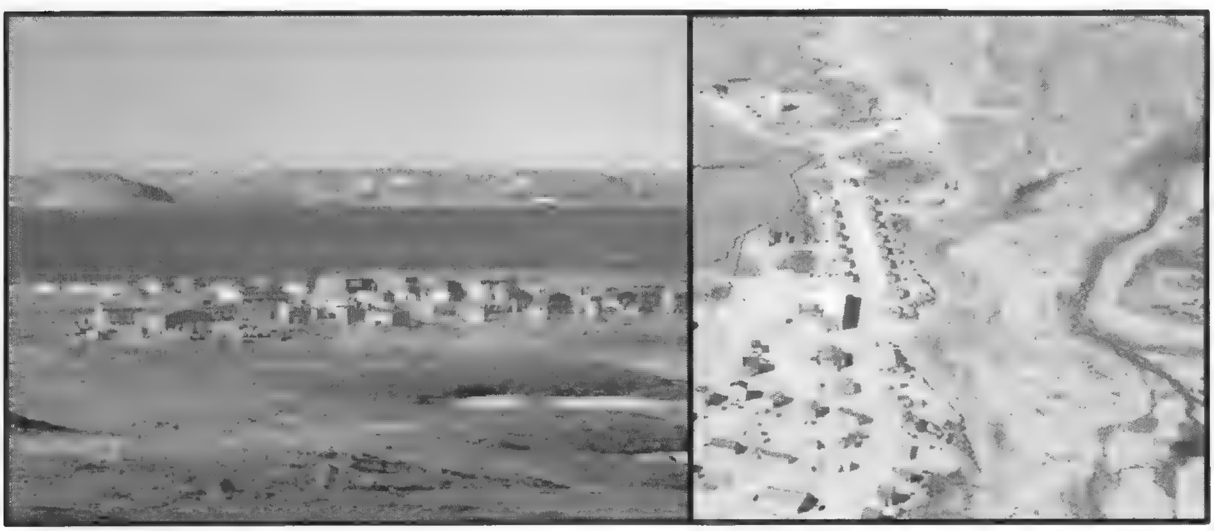

Figure 37 – Tasiujaq Shoreline

4.1.4 Kuujjuaq

Table 7 – Kuujjuaq Details

Population	2,754	
Location	Latitude: 58° 6' 26.4" (58.1073°) north Longitude: 68° 23' 58.8" (68.3997°) west Elevation: 16 meters (52 feet)	
Description	Kuujjuaq is the regional hub for Nunavik. 1700 Inuktitut, 500 French, and 500 English speaking people live here. The Kuujjuaq harbor is located north of town. Marine facilities include two boat launches, a seasonal floating dock, trailer storage service, a small marina supply and repair shop, a VHF radio station (with one repeater station upriver and one repeater downriver). The Kativik Regional Police Force operates a vessel out of the harbor as a SAR asset.	
Average Annual Commercial Marine Activity	Merchant General	8-12
	Merchant (Tanker)	1-2
	Merchant Passenger	1
	Other	n/a

Figure 38 - Kuujjuaq Harbour

Figure 39 - Kuujjuaq Harbour At High Tide with Floating Dock.

Figure 40 - Kuujjuaq Marine Facilities From Above

Figure 41 - A Kativik Regional Police Force SAR Vessel in Kuujjuaq

4.1.5 Kangiqsualujjuaq

Table 8 – Kangiqsualujjuaq Details

Population	942	
Location	Latitude: 58° 41' 29.1" (58.6914°) north Longitude: 65° 57' 8.9" (65.9525°) west Elevation: 19 meters (62 feet)	
Description	Kangiqsualujjuaq is the easternmost village of Nunavik, located about 160 km to the north-east of Kuujjuaq. It is situated 25 km from Ungava Bay on the George River, nestled at the end of a cove called Akilasakalluq. Tidal movements reach as far upstream as the village so that, at low tide, water recedes almost entirely from the cove. Kangiqsualujjuamiut's summer life is therefore closely linked to the rhythm of the tides. The village itself stands in the shadow of an imposing granite rock outcropping which rises to the north of the bay. Despite its northerly location, the valley sheltering the village is treed.	
Average Annual Marine Commercial Activity	Merchant General	3-5
	Merchant (Tanker)	2-3 (4 in 2012 – construction project?)
	Merchant Passenger	1
	Other	n/a

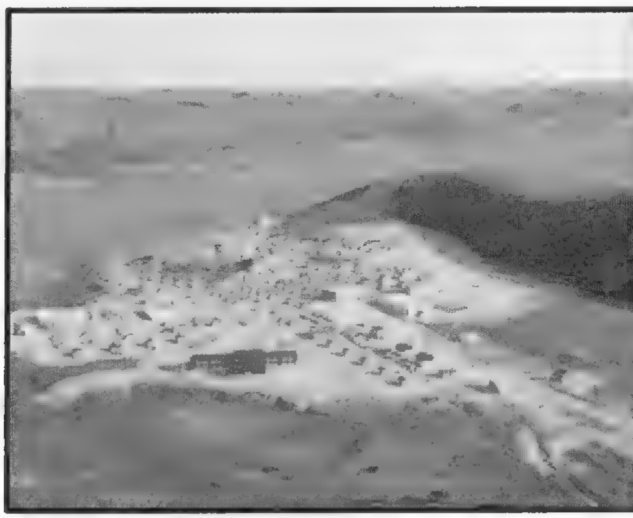

Figure 42 – Kangiqsualujjuaq

Figure 43 - Harbour at Kangiqsualujjuaq

4.1.6 Cape Dorset

Table 9 – Cape Dorset Details

Population	1,441	
Location	Latitude: 64° 14' 1.6" (64.2338°) north Longitude: 76° 32' 37.4" (76.5437°) west	
Description	Cape Dorset is situated on an island where, at low tide, you can walk to the mainland. Dorset Island itself is fairly flat ground with some rolling hills. The community is a common port of call for cruise ships as the hamlet is renowned for its arts and culture.	
Typical Commercial Marine Activity	Merchant General	6
	Merchant (Tanker)	1-3
	Merchant Passenger	2-3
	Other	n/a

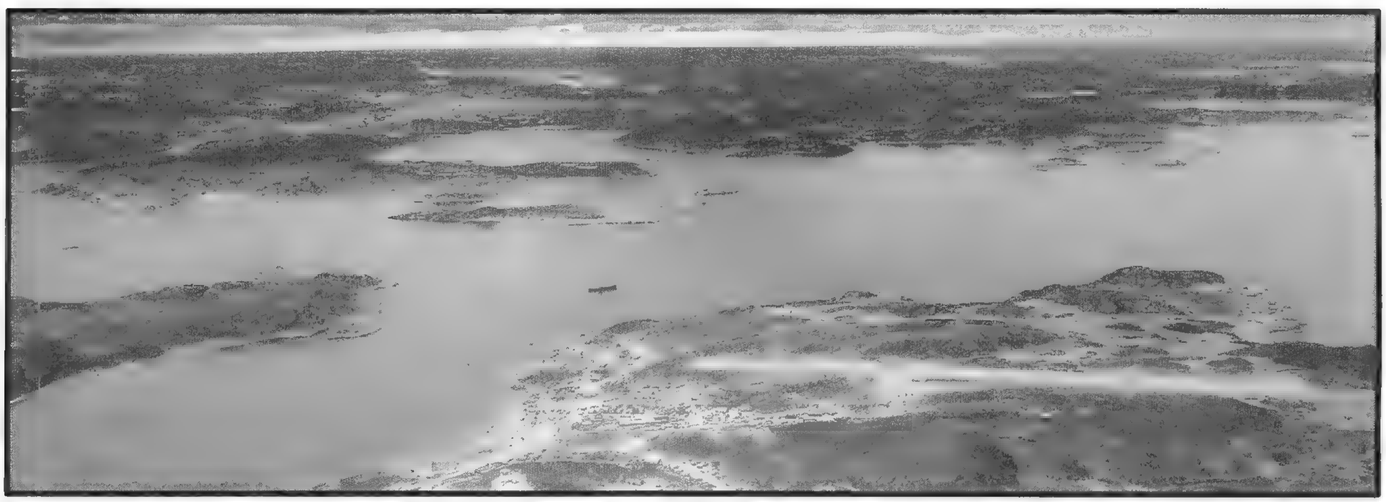

Figure 44 - Aerial View of Dorset Island

4.1.7 Kimmirut

Table 10 – Kimmirut Details

Population	389[12]	
Location	Latitude: 62° 50' 50.1" (62.8473°) North Longitude: 69° 52' 12.3" (69.8701°) West Elevation: 13 meters (43 feet)	
Description	Kimmirut is a traditional Inuit hamlet located on the southernmost peninsula of Baffin Island, just across the Hudson Strait from mainland Québec. The hamlet overlooks the waters of Glasgow Inlet and sits at the mouth of the Soper Heritage River, providing shelter for the community boat launch area.	
Average Annual Commercial Marine Activity	Merchant General	5
	Merchant (Tanker)	1-2
	Merchant Passenger	2-3
	Other	0

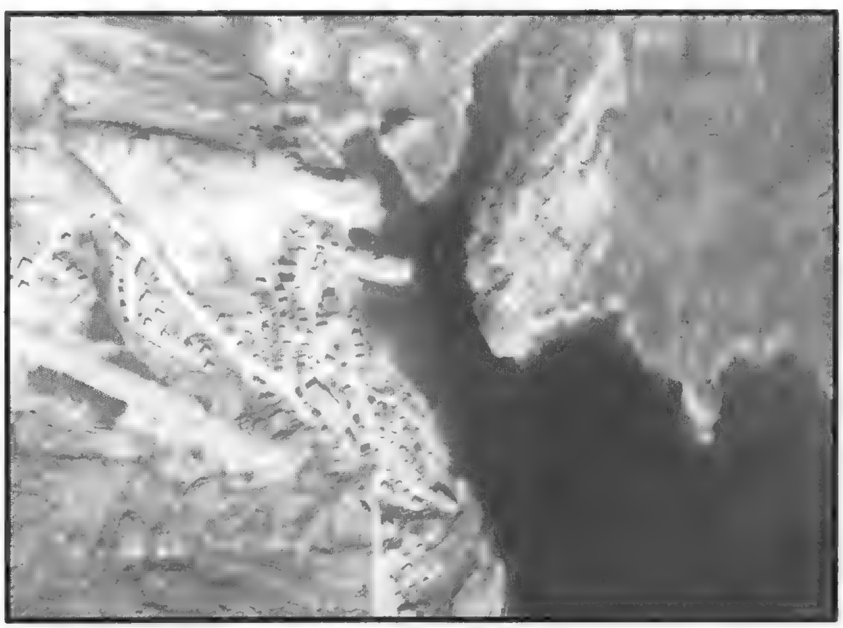

Figure 45 - Kimmirut From Above

[12] Population in rapid decline. -14.5% since 2011.

4.1.8 Quaqtaq

Table 11 – Quaqtaq Details

Population	403	
Location	Latitude: 61° 2' 1.5" (61.0338°) North Longitude: 69° 36' 53" (69.6147°) West Elevation: 1 meter (3 feet)	
Description	The village of Quaqtaq is located on the eastern shore of Diana Bay, called Tuvaaluk (the large ice field) in Inuktitut, on a peninsula which protrudes into the Hudson Strait where it meets Ungava Bay. Mountains stand on the peninsula to the north and to the south-east are short, rocky hills. The region around Diana Bay is rich with sea mammals as well as fish and seafood, including mussels, scallops and clams. Currents are very strong neat Quaqtaq, reaching 5kts with each incoming and outgoing tide.	
Average Annual Commercial Marine Activity	Merchant General	5-9
	Merchant (Tanker)	1-4
	Merchant Passenger	0
	Other	0

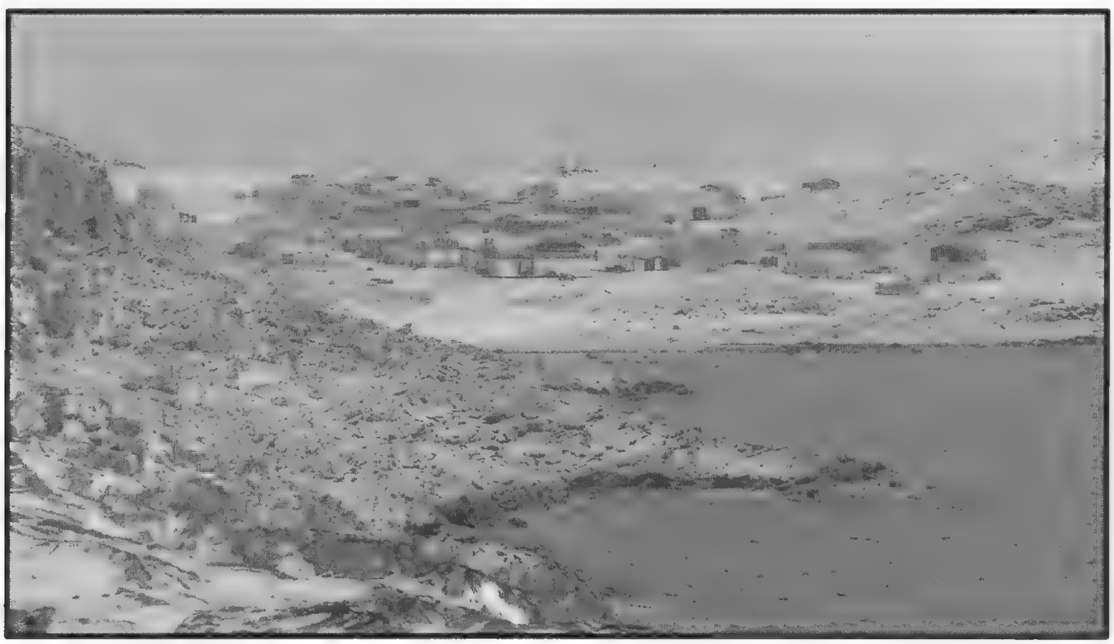

Figure 46 - Quaqtaq Shoreline

4.1.9 Iqaluit

Table 12 – Iqaluit Details

Population	7,740	
Location	Latitude: 63° 44' 49.1" (63.747°) North Longitude: 68° 31' 2.2" (68.5173°) West Elevation: 14 metres (46 feet)	
Description	Iqaluit is the capital city of Nunavut. It is a major economic driver for the region, serving as a hub for commerce, government services, transportation, and cultural exchange. The airport was upgraded to increase capacity in 2017. Iqaluit is on track to have a deep water port installation south of the city complete by 2020. An extensively used small craft harbor is also being expanded. Iqaluit has a MCTS centre which operates seasonally from May to December, offering services in English and French.	
Average Annual Commercial Marine Activity	Merchant General	12
	Merchant (Tanker)	6
	Merchant Passenger	5
	Other	1

Figure 47 - City of Iqaluit with Frobisher Bay in Background

4.1.10 Pangnirtung

Table 13 – Pangnirtung Details

Population	1,481	
Location	Latitude: 66° 8' 47.1" (66.1464°) North Longitude: 65° 41' 59.9" (65.7°) West Elevation: 1 metre (3 feet)	
Description	Pangnirtung is an Inuit hamlet, Qikiqtaaluk Region, located in Pangnirtung Fjord, off of Cumberland Sound. The hamlet has a well-used small craft harbor. Strong tidal variation restricts vessel movement in and out of the community to only 2hrs on either side of high tide. In 2001, a survey by Small Craft Harbors Canada determined the community had 150 boats. During the same survey, 192 people reported regularly hunting and fishing. Tourism is popular, with most marine excursions visiting Auyuittuq National Park or travelling seaward to Cumberland Sound for fishing, observing wildlife, and whale watching.	
Average Annual Commercial Marine Activity	Merchant General	5
	Merchant (Tanker)	1
	Merchant Passenger	2 or 4
	Other (Fishing)	1

Figure 48 - Pangnirtung Fjord

4.1.11 Qikiqtarjuaq

Table 14– Qikiqtarjuaq Details

Population	598	
Location	Latitude: 67° 33' 19.7" (67.5555°) North Longitude: 64° 1' 29.7" (64.0249°) West Elevation: 1 metre (3 feet)	
Description	110 vessels were reported to exist in this community as of 2001 during a Canadian Small Craft Harbors report. Tourism, subsistence and commercial fishing are the primary drivers for marine activity. Qikiqtarjuaq residents mostly speak Inuktitut, with a small minority of English speaking people. Many boaters in the community have MED-A3 and SVOP certificates as a result of working aboard commercial fishing vessels.	
Average Annual Commercial Marine Activity	Merchant General	3 or 4
	Merchant (Tanker)	2
	Merchant Passenger	0 or 1 (alternating years)
	Fishing	3 to 5

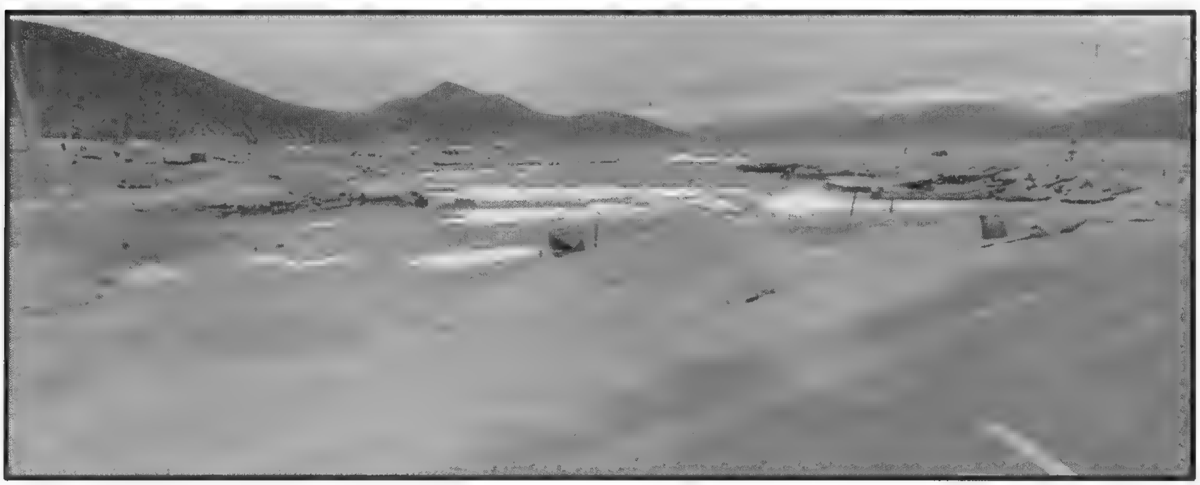

Figure 49 - Google Street View of Qikiqtarjuaq Small Craft Harbour

Table 15 – INNAV Database for Port Visits for SAR Area 010 NORDREG Communities

		Total	Merchant General	Tanker	Passenger	Research	Fishing	Vehicle Transport	Other
Iqaluit	2016	28	11	4	6	2	0	2	3
	2015	22	12	6	2	0	0	0	2
	2014	35	17	5	6	2	0	2	3
	2013	27	14	7	3	0	0	0	3
	2012	24	12	5	3	0	0	0	4
Pangnirtung	2016	10	5	1	2	0	2	0	0
	2015	7	4	2	0	0	1	0	0
	2014	13	5	1	4	0	2	1	0
	2013	12	7	1	4	0	0	0	0
	2012	8	4	1	0	0	0	0	3
Kimmirut	2016	9	5	2	2	0	0	0	0
	2015	7	5	1	1	0	0	0	0
	2014	9	4	1	3	0	0	1	0
	2013	6	5	1	0	0	0	0	0
	2012	5	2	1	1	0	0	1	0
Cape Dorset	2016	11	6	1	2	0	0	2	0
	2015	11	6	3	2	0	0	0	0
	2014	10	5	1	3	0	0	0	1
	2013	12	6	2	2	0	0	0	2
	2012	7	2	1	0	1	0	2	1
Qikiqtarjuaq	2016	10	4	2	1	0	3	0	0
	2015	10	3	1	0	0	2	0	4
	2014	11	2	2	0	0	6	1	0
	2013	6	3	1	1	0	0	1	0
	2012	5	3	1	1	0	0	0	0
Quaqtaq	2016	9	5	1	0	0	0	0	3
	2015	10	9	1	0	0	0	0	0
	2014	10	6	3	0	0	0	1	0
	2013	5	4	1	0	0	0	0	0
	2012	9	8	0	0	0	0	0	1
Kangiqsualujjuaq	2016	6	3	0	0	0	0	1	2
	2015	7	4	2	1	0	0	0	0
	2014	5	4	1	0	0	0	0	0
	2013	8	5	2	1	0	0	0	0
	2012	10	4	3	1	0	0	1	1

Kuujjuaq	2016	11	10	1	0	0	0	0	0
	2015	14	12	1	1	0	0	0	0
	2014	12	8	2	1	0	0	1	0
	2013	9	6	1	0	0	0	2	0
	2012	11	6	1	0	0	0	3	1
Tasiujaq	2016	5	3	0	0	0	0	1	1
	2015	5	4	1	0	0	0	0	0
	2014	6	5	1	0	0	0	0	0
	2013	6	4	1	0	0	0	1	0
	2012	5	3	1	0	0	0	1	0
Aupaluk	2016	7	6	0	0	0	0	0	1
	2015	8	7	1	0	0	0	0	0
	2014	6	5	1	0	0	0	0	0
	2013	6	4	1	0	0	0	1	0
	2012	5	3	0	0	0	0	1	1
Kangirsuk	2016	6	5	0	0	0	0	0	1
	2015	9	6	1	0	0	0	2	0
	2014	8	5	2	0	0	0	1	0
	2013	9	4	1	0	0	0	4	0
	2012	6	5	0	0	0	0	0	1

4.2 Deep Water Ports

Iqaluit is the only Arctic community with a deep water port. It is currently under construction and scheduled to begin operation in 2020. The plans include one berth for commercial shipping, a large ramp for barges to unload onto, and increased capacity in the city's small craft harbor. The people of Iqaluit and Government of Nunavut predict this project will vastly increase maritime activity in the Arctic and foresee a need to expand this (yet to be completed) port in the near future.[13]

Qikiqtarjuaq has plans for a deep water port which include a SAR resource, sealift staging area, small craft harbor, fisheries offices, and cruise ship terminal among other facilities. The vision for the port demonstrates a keen interest for Qikiqtarjuaq to become a shipping hub and partner with all levels of government. The community lacks the funding to begin work.

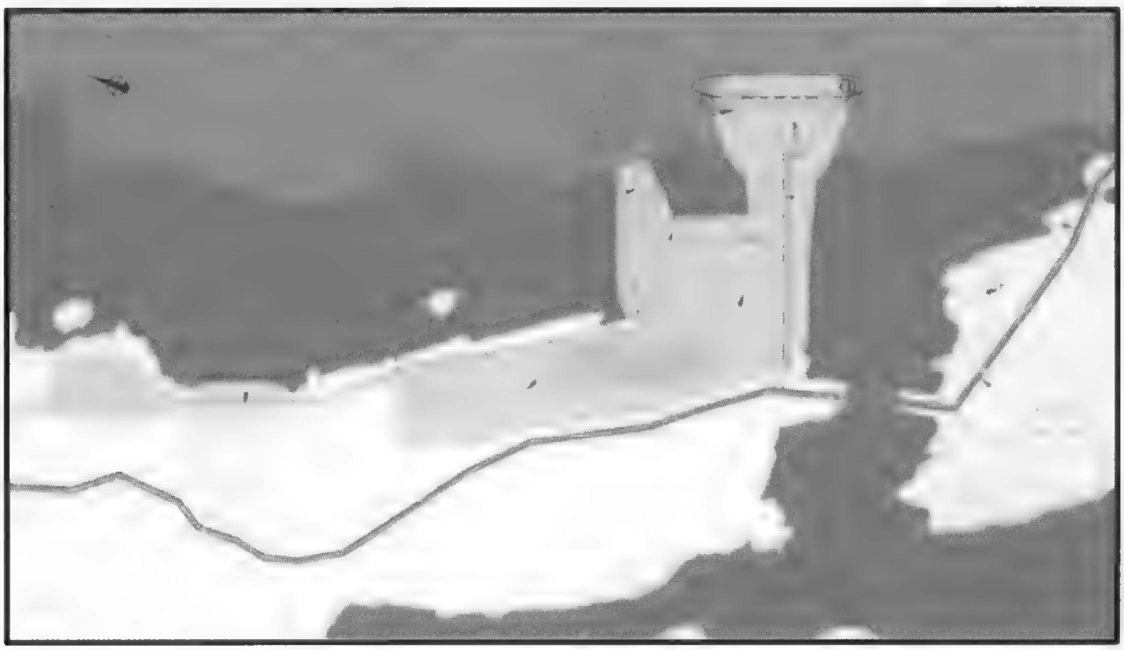

Figure 50 - Draft plan of the Iqaluit Port

[13] Government of Nunavut Emergency Management Office

4.3 Review of Maritime and Economic Activities

Area 010 sees a flurry of activity during the ice-free season. Commercial vessels carrying supplies, vehicles, and fuel depart from Montreal, Halifax, and St. Johns at first sign of a navigable passage. Most commercial vessels will make 3 trips to and from the NORDREG Zone each year.[14]

Research & fishing vessels follow suite. Most merchant passenger vessels will gradually explore further North beginning in August. The most common time for vessels to traverse the Northwest Passage is during the final week of August and first week of September. 3 Cruise ships attempted this in 2016.

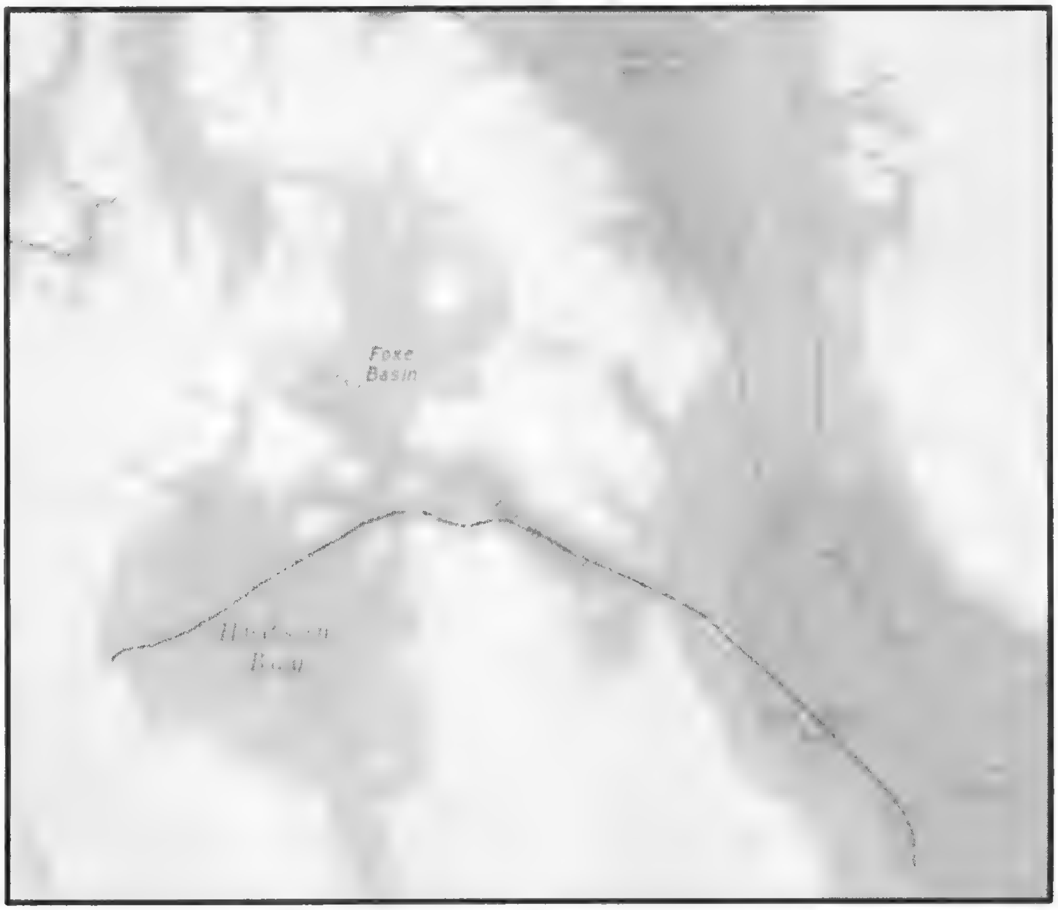

Figure 51 – 2010 NORDREG Data shows the common shipping routes in Area 010. Darker Color represents vessel traffic, but should not be relied on for present indicators due to the age of the data. As of 2016, the port of Churchill is not operating.

[14] As noted by INNAV data.

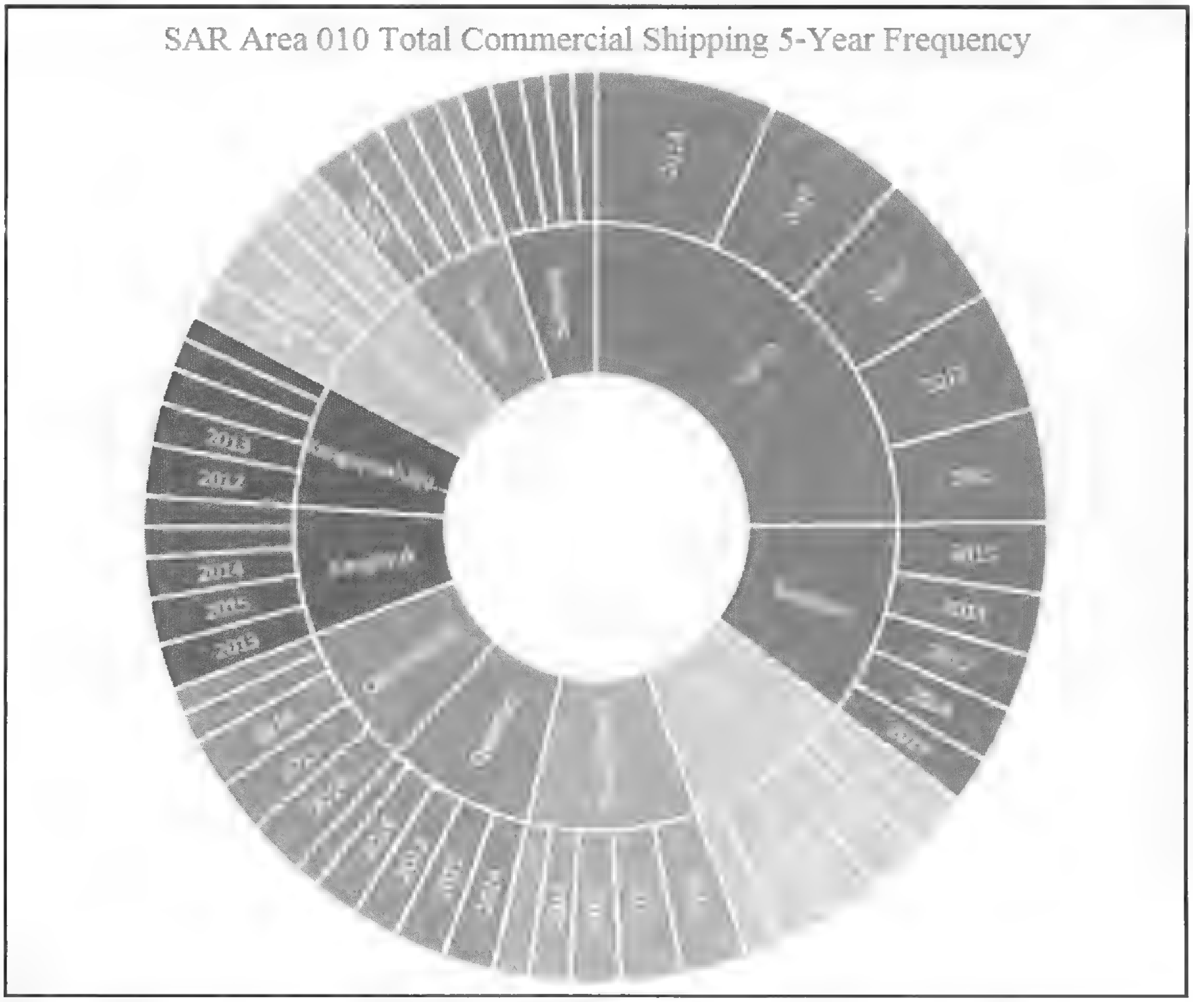

Figure 52 – 5 year average vessel traffic in each area 010 community as reported to NORDREG. Notice that the 4 largest communities (Iqaluit, Kuujjuaq, Cape Dorset, and Pangnirtung) are responsible for over %50 of vessel movements.

4.3.1 Ferry Operations

A ferry route has been proposed between Happy Valley Goose Bay and Iqaluit in 2020, once the latter has completed development of the Iqaluit deep sea port. The proposal, by Woodward group of Companies, calls for 3 days at sea and 4 hours for unloading of vehicles, freight, and passengers in Iqaluit. It is expected this will reduce the cost of travel to – and cost of living in – Iqaluit.

Kilabuk Outfitters and Alivaktuk Outfitters in Pangnirtung offer ferry services to and from Auyuittuq National Park as well as fishing and sightseeing charters in the surrounding area of Cumberland Sound.

4.3.2 Commercial Fishing

Commercial fishing predominantly exists in Davis Straight. Commercial fishing vessels make stopovers in Pangnirtung, Qikiqtarjuaq, and Iqaluit. The main fishing grounds are on the Labrador Shelf, in water less than 1000m deep, as well as Northern portions of Davis Straight above 70°N.

Commercial Fishing Vessels typically drops off their catch in Nuuk and other Greenland communities as they are better situated both economically and geographically to process fish. Factory fishing vessels can also be found in the region. These vessels mainly deposit catch at Southern Canadian ports as communities on Baffin island lack the infrastructure to process large quantities of fish.

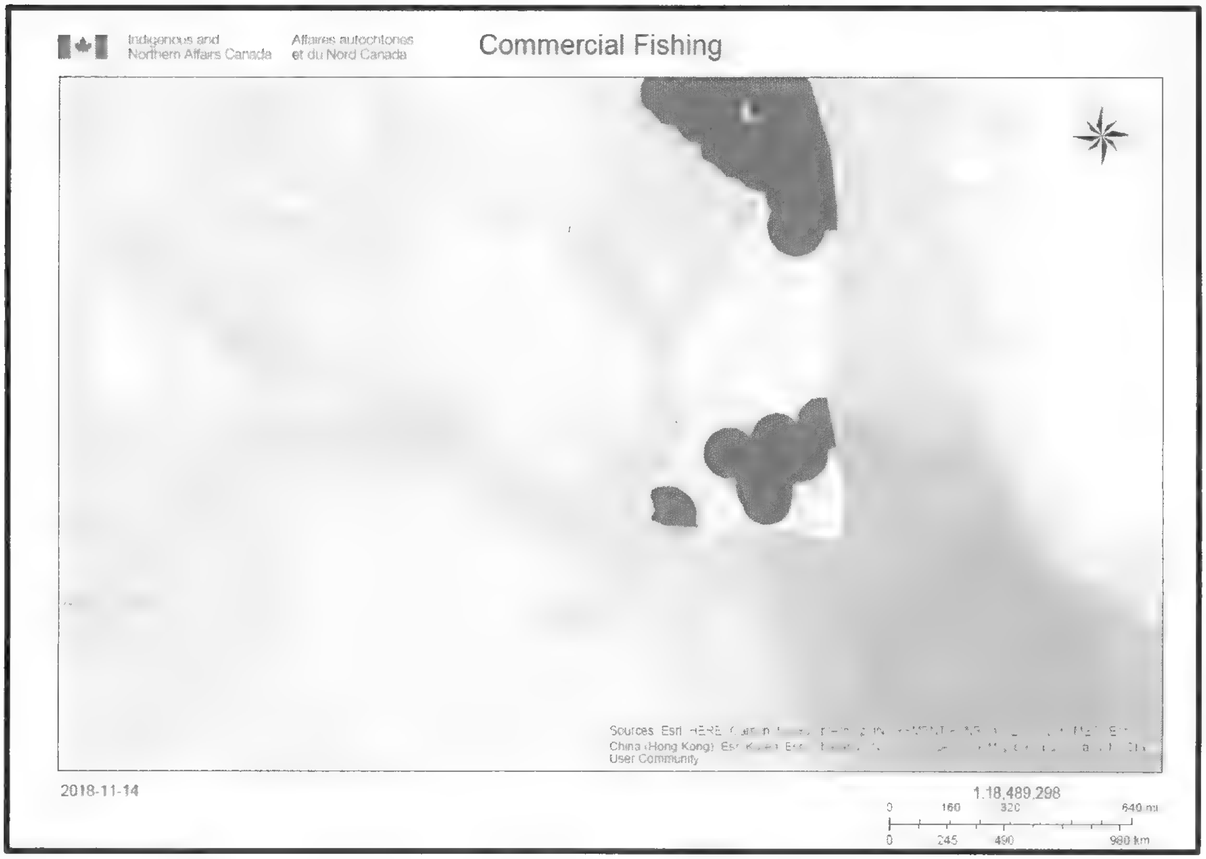

Figure 53 – INAC Generated Heat Map of Popular Fishing Areas in SAR Area 010

4.3.3 Recreational Fishing

Quantifying recreational fishing in Area 010 is elusive. Many people in the region fish, but due to Inuit traditions, food insecurity, and high unemployment; fishing is rarely done recreationally by locals.

Guides and outfitting companies exist in every community, which offer fishing trips to visitors and tourists.

It is known that 472 PCOC's have been issued to addresses in Nunavut since 1991, perhaps for the purpose of boating and fishing in other provinces. For example, in Yukon, proof of competency is not required in Nunavut or the NWT.

4.3.4 First Nations Maritime Activities

Inuit peoples in Nunavik and Nunavut maintain a close relationship with the geography in which they live. "Harvesting" is the general term used to describe the act of hunting, trapping, gathering, and fishing in Northern communities.

Harvesting is reported as a percentage of people in a community who take part in hunting and fishing at various frequencies. It is challenging to create any distinction between those who exclusively hunt versus the population of mariners. Participating in once activity is not mutually exclusive of the other. Therefore, any inferences of sea-going populations will be an overestimation.

Table 16 – Inuk Harvesting Frequency

	Total Inuk Population	Harvest Weekly	Less than Weekly, at least Monthly	Less than Monthly	
Iqaluit	4,270	*1,205*	*680*	*254*	
Kuujjuaq	2,000	*563*	*335*	*96*	
Pangnirtung	1,390	*392*	*222*	*83*	
Cape Dorset	1,345	*380*	*214*	*80*	
Kangiqsualujjuaq	900	*253*	*151*	*43*	
Qikiqtarjuaq	565	*159*	*90*	*34*	
Kangirsuk	535	*150*	*90*	*26*	
Quaqtaq	380	*107*	*64*	*18*	
Kimmirut	360	*102*	*57*	*21*	
Tasiujaq	345	*97*	*58*	*17*	
Aupaluk	205	*58*	*34*	*10*	
Nunavut	23030	*28.22%*	*15.94%*	*5.95%*	**50.11%** of Inuit in Nunavut participate in harvesting activities. The remainder do not hunt, fish, gather, or trap
Nunavik	8710	*28.13%*	*16.76%*	*4.82%*	**49.71%** of Inuit in Nunavik participate in harvesting activities. The remainder do not hunt, fish, gather, or trap

Figure 54 – INAC generated heat map of popular fishing and gathering areas for Inuk since 1960. Note the differences between commercial fishing and traditional fishing regions.

Most small craft vessels (97%) in Arctic communities are 26' or less LOA. The average lifespan for a vessel stored on its hull on a beach is 3 to 5 years in the Arctic. Without regular maintenance or proper storage, many small craft in the Arctic are in need of repairs and replacement, jeopardizing their seaworthiness.

4.3.5 Eco-tourism Operations

All communities operate one or more outfitters which typically offer professional guides, vessels, snowmobiles, clothing, hunting, fishing, and camping services and equipment. Popular marine activities include:

- Whale watching
- Seal and seabird wildlife tours
- Ice fishing
- Fishing
- Iceberg viewing

4.3.6 Commercial Cargo Operations

Table 17 – List of Regularly Transiting Vessels Obtained through NORDREG

Merchant Tankers:	LOA (m)	Canadian Marine Transportation Safety Board Remarks
Alsterstern	161	
Dara Desgagnes	124	
Espada Desgagnes	228	
Havelstern	161	
Jana Desgagnes	123	
Maria Desgagnes	120	On 12 September 2005, Maria Desgagnes collided with Sailing vessel El Tio in the St. Lawrence River.
Nanny	116	Ran aground October 25 2012 while outbound from Baker Lake, NU damaging forward section of hull. Refloated Oct 27 and proceeded to St. John's, NFLD for repairs. No injuries or pollution reported. Nanny ran aground a second time on Oct 14, 2014 near Chesterfield Inlet.
Sarah Desgagnes	147	
Travestern	161	
Uvaq	164	
Ugale	195	
Merchant General:		
Anna	173	On Aug 29, 2017; Vessel lost power and subsequently ran aground near Beauharnois, Quebec.
Avataq	113	
Claude A Desgagnes	138	On 6 Nov 2013, struck the approach wall of Iroquois Lock in St. Lawrence Seaway. Subsequently, the vessel ran aground. No pollution or injuries reported, the ship sustained minor damage.
Mitiq	136	
Qamutik	136	
Rosaire A. Desgagnes	138	
Sedna Desgagnes	139	
Umiavut	113	
Zelada Desgagnes	138	

4.3.7 Cruise Ship Operations

Table 18 – List of Regularly Transiting Cruise Ships Obtained through NORDREG

Merchant Passenger	LOA (m)	Canadian TSB Remarks
Akademik Ioffe	117	Under investigation due to grounding on August 24, 2018.[15]
Bremen	111	
Crystal Serenity	250	
Hanse Explorer	47	
Hanseatic	123	On 29 August 1996, ran aground in Simpson Straight, NWT.
KAPITAN KHLEBNIKOV	129	
L'Austral	142	
Le Boreal	142	
Le Soleal	142	
NatGeo Explorer	112	
Ocean Endeavour	137	
Sea Adventurer	100	
Sea Explorer I	90	
Silver Explorer	108	
The World	196	

[15] As of November 9, 2018 this investigation is in the examination and analysis phase.

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Nunavik Trip Report
March 25 to 29, 2019
Jean-Sébastien Landry

Communities visited:

Kangirsuk
Aupaluk
Puvirnituq
Umiujaq
Kuujjuarapik

Dates	Communities	Focus	Highlights
25/03/19	Kangirsuk	○ Explain CCGA program ○ Fill missing documentation to sign up members. ○ Confirm training dates	The community with the highest propensity I've ever seen. Dates for training are booked for July. High propensity is due to death in the community on summer 2018.
25/03/19	Aupaluk	○ Explain CCGA program ○ Fill missing documentation to sign up members.	Very small community (200 pop). However, the community population is expected to increase along with numerous infrastructure investment. The mayor showed limited interest and we felt it had an impact on the other members as well.
26/03/19	Puvirnituq	○ Explain CCGA program ○ Fill missing documentation to sign up members. ○ Training dates awaiting [redacted]	Very nice office with great technology. We had a first meeting with the current and outgoing mayoress. They express they were relieved when we explained we were there to work with them on marine Search and Rescue. The second

s.19(1)

s.19(1)

		[redacted] confirmation	meeting was with local Search and Rescue Team in which they showed great enthusiasm.
29/03/19	Umiujaq	○ Distribution of TC certificates, CCGA hoodies and tuques ○ Informal explanation of CG Exercising Team	History was made! March 29th marks the first fully certified CCGA unit in Nunavik.
29/03/19	Kuujjuarapik	○ Explain CCGA program ○ Fill missing documentation to sign up members. ○ Training dates awaiting Michael Cameron confirmation	Along with Kuujjuaq, Kuujjuarapik is one of the communities with the highest rate of incidents in Nunavik. Approximately 10 maritime incidents were reported last year per the SAR group. That is a high contrast compared to RAMSARD stating only 1 incident occurred in Kuujjuaarapik in five years. Interestingly, when there's a missing person call, they ask Air Inuit to fly over and to advise if they spot someone disabled. We met with a community member that drifted from Kuujjuaarapik to half-way over to the Flaherty islands.

Other highlights

s.19(1)

- 50 tuques were distributed across the communities except Umiujaq
- Charts were distributed in every community
- We are greeted with warmth in every community
- No polar bears were seen. However, a community member in Umiujaq explained how one approached his camp and stood on his two feet
- No jokes were said during the entirely of the trip

What I've learned

- CCGA-Q is preparing to offer a lot of training in Nunavik this upcoming spring, summer and winter
- The addition of [redacted] seems to help CCGA meet more community members
- RAMSARD results of Hudson Bay and James Bay are not representative
- RAMSARD is not operational oriented

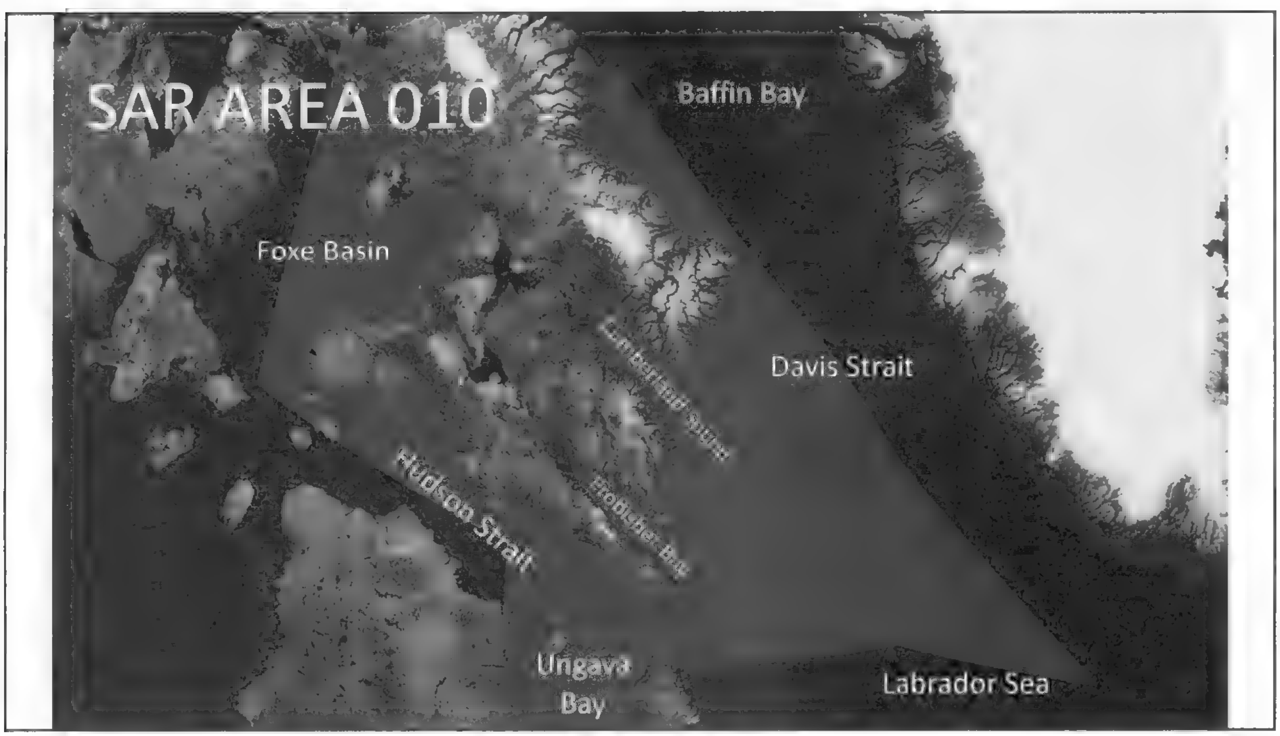
Operation notes

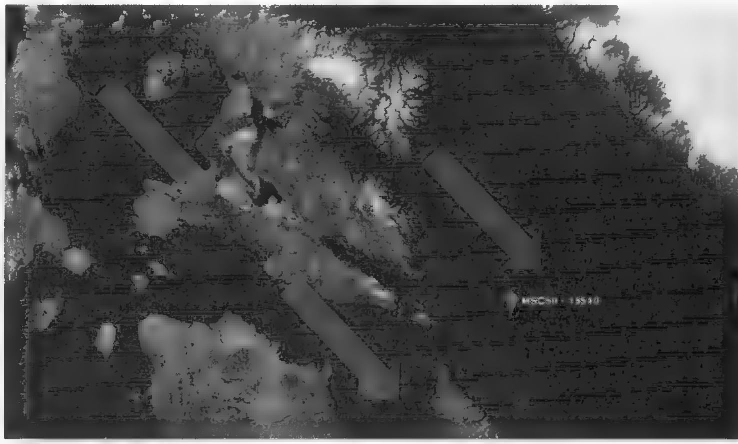
- An exercising team this summer in Umiujaq was proposed
- The readjustment of the CCGA-Q training program for the Arctic is expected, but will take time (2020)
- Prevention program distribution in Nunavik would add to the overall strategy
- It was proposed CCGA-Q has charts from Coast Guard for training purposes

Conclusion

Staying persistent and patient in the next few years will create a maritime SAR culture in Northern Quebec. CCGA-Q is on the right track for a successful training season this year with a high number of members interested participating in courses. However, different variable such as the climate, hotels, restaurants, and instructors' availability can affect such success. Instructor numbers are predicted to be on the rise for CCGA-Q. However, challenges remain concerning their administrative autonomy and may increase workload for [redacted] and other lead of the organization.

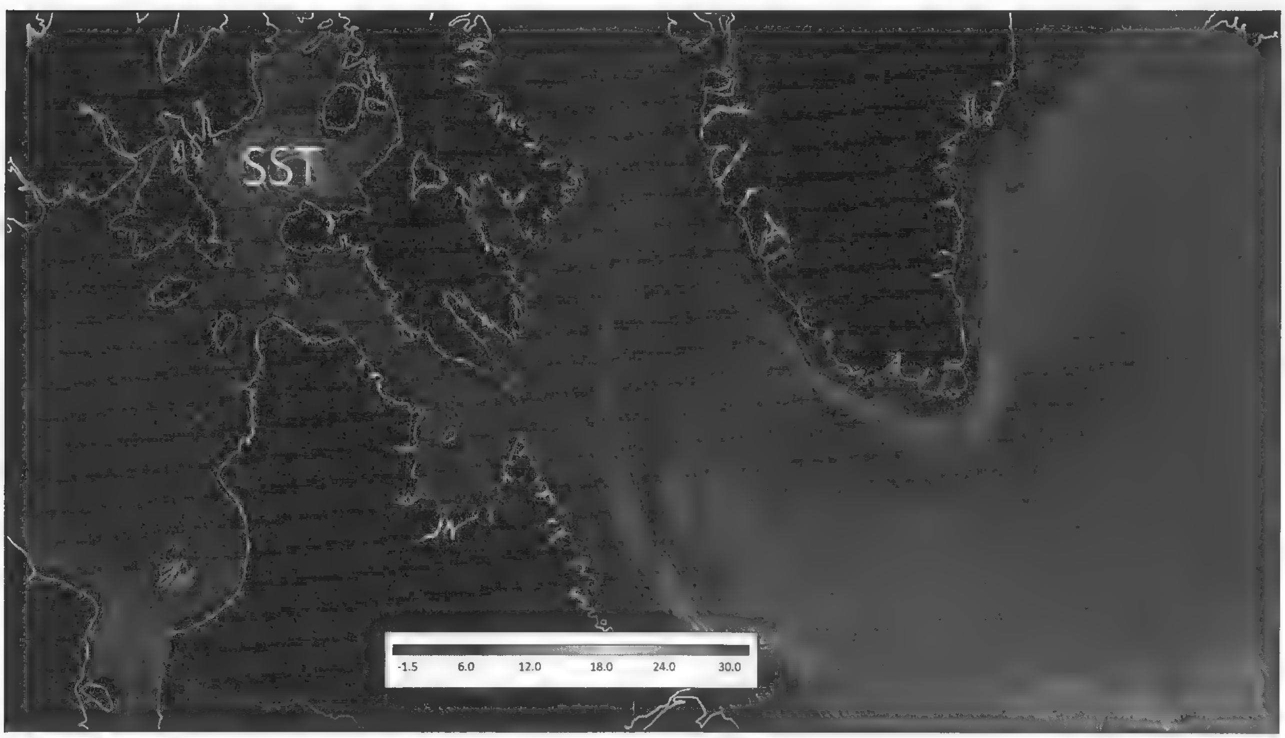

Arctic SAR Areas
Environmental Scan
010, 155, 259

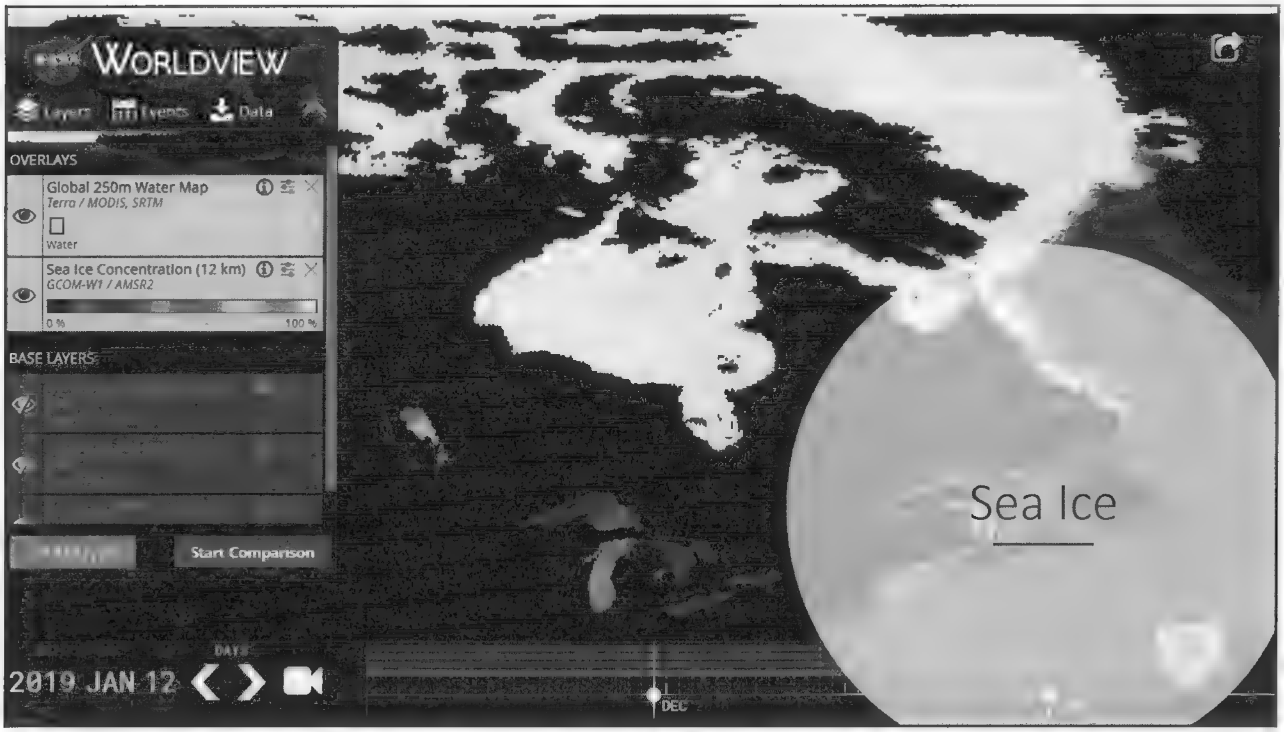

SAR AREA 010
Baffin Bay
Foxe Basin
Davis Strait
Hudson Strait
Frobisher Bay
Ungava Bay
Labrador Sea

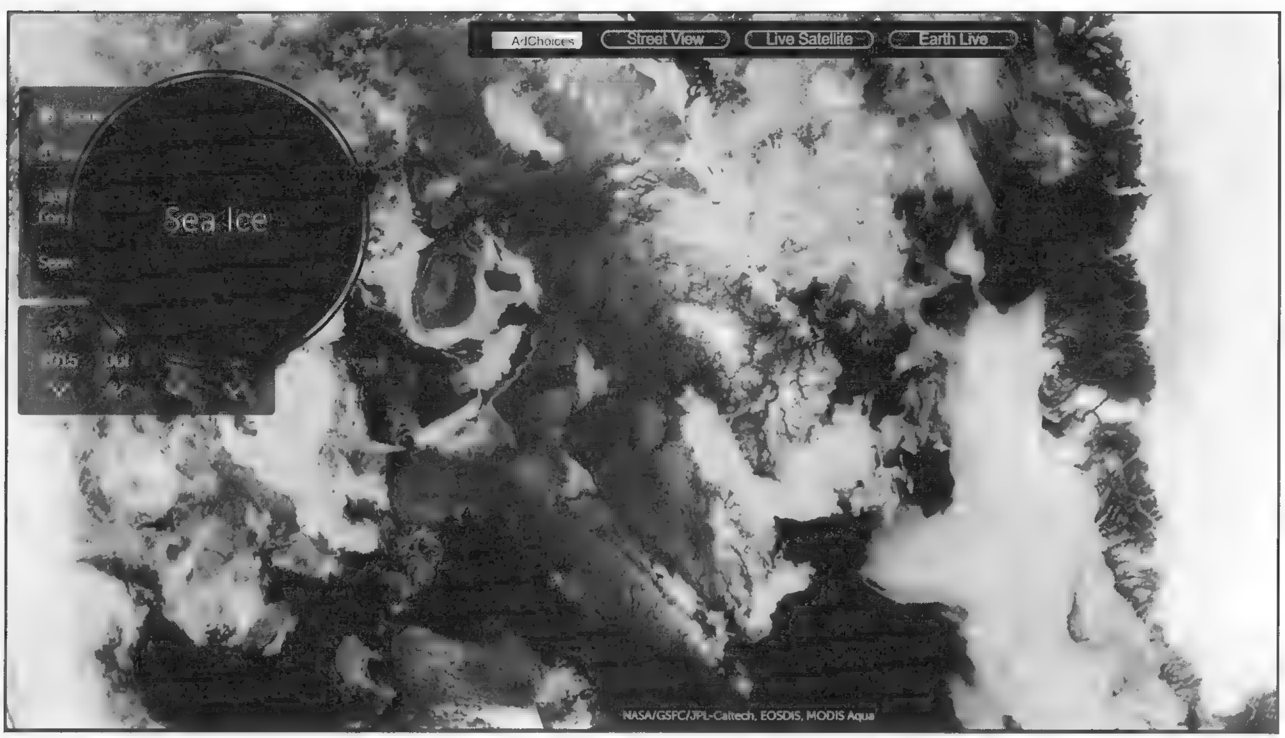


Winds

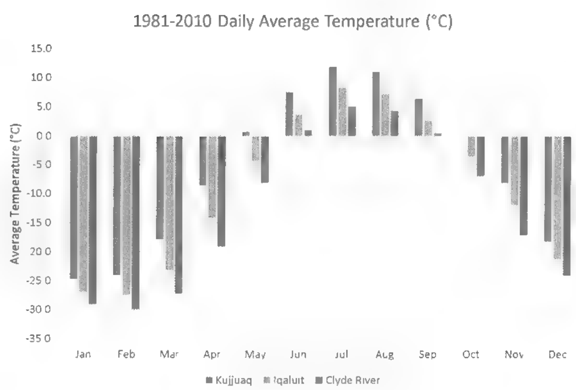
- Limitations of MSC50 grid points
- Airport wind vectors
- Katabatic & nearshore winds

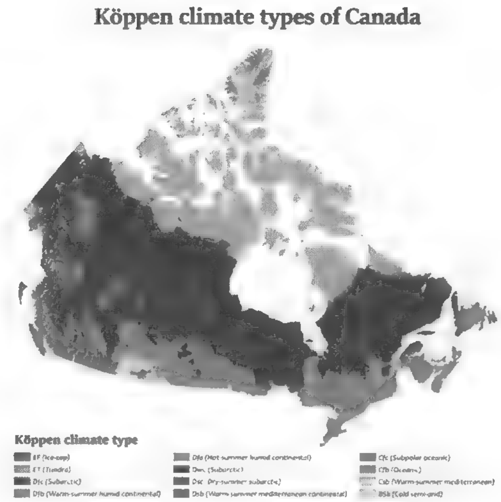



WORLDVIEW
Layers
Events
Data
OVERLAYS
Global 250m Water Map
Terra / MODIS, SRTM
Water
Sea Ice Concentration (12 km)
GCOM-W1 / AMSR2
0 %
100 %
BASE LAYERS
Start Comparison
DAYS
2019 JAN 12
DEC
Sea Ice


AdChoices
Street View
Live Satellite
Earth Live
Sea Ice
NASA/GSFC/JPL-Caltech, EOSDIS, MODIS Aqua

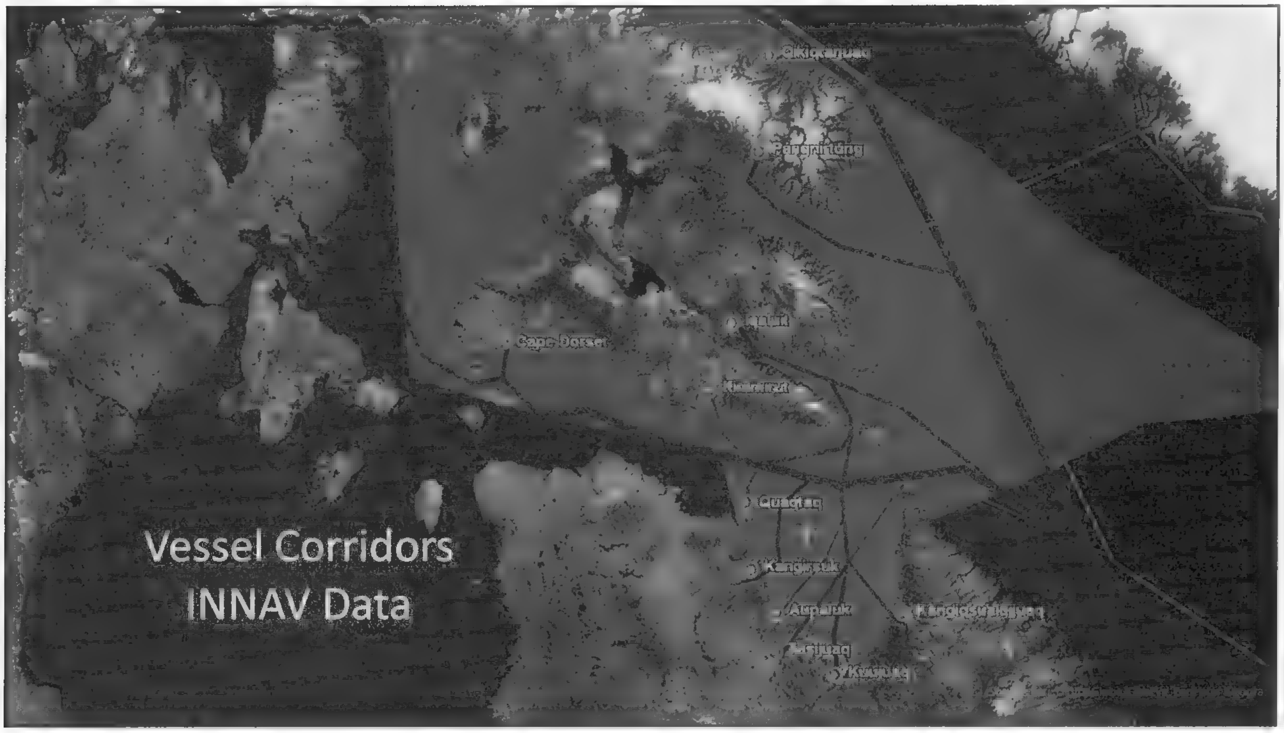
Area 010 has a polar climate.





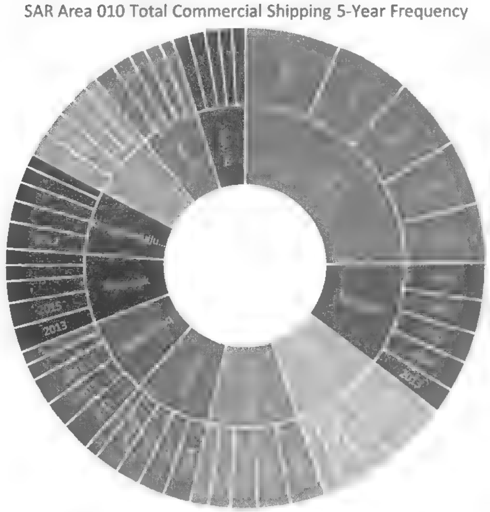
Learning about remote comn

- Blogs
- Google street view
- Flickr….!
- Mapcarta
- Town websites



INNAV Database for Port Visits for SAR Area 010 NORDREG Communities

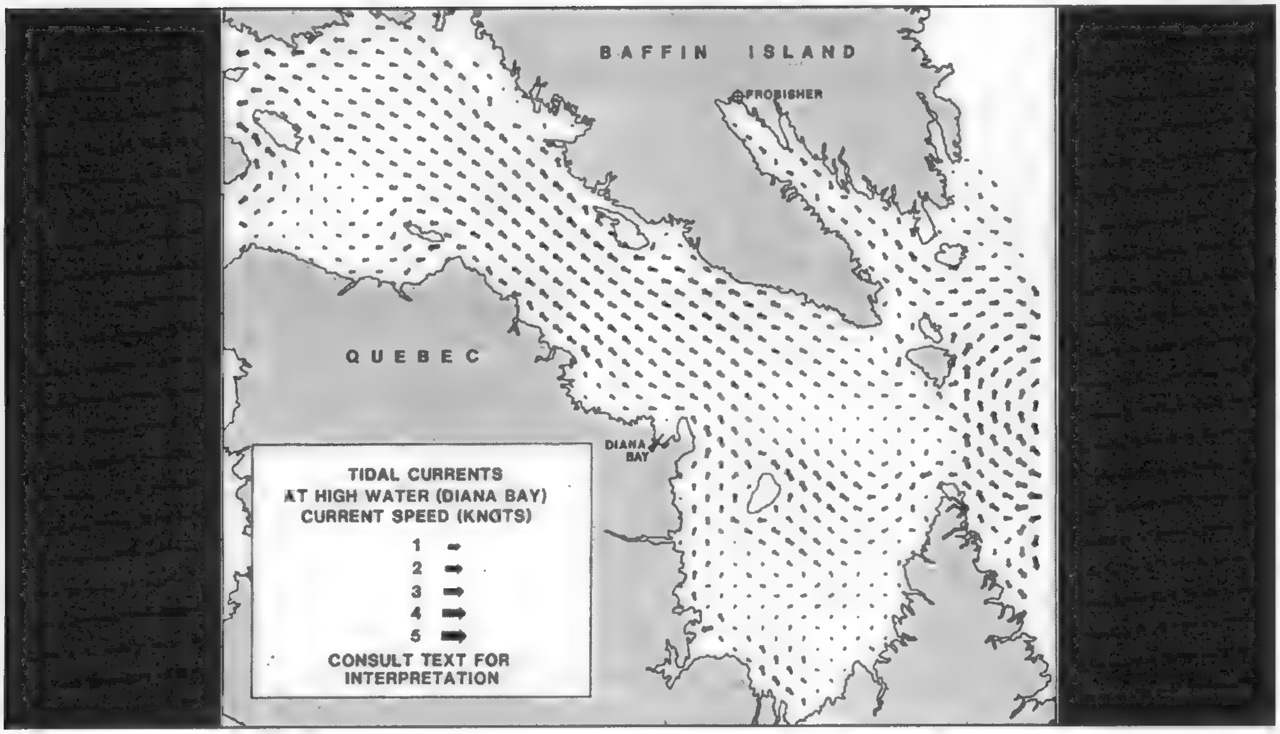
SAR Area 010 Total Commercial Shipping 5-Year Frequency

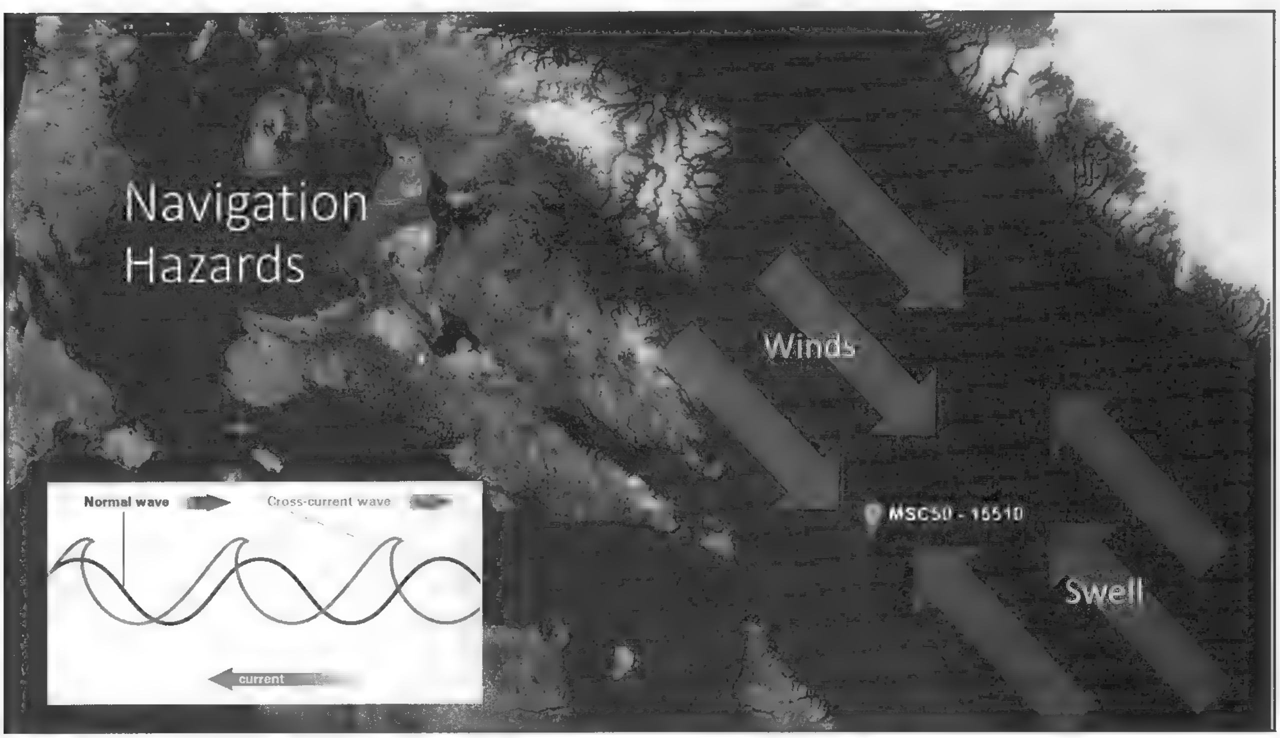


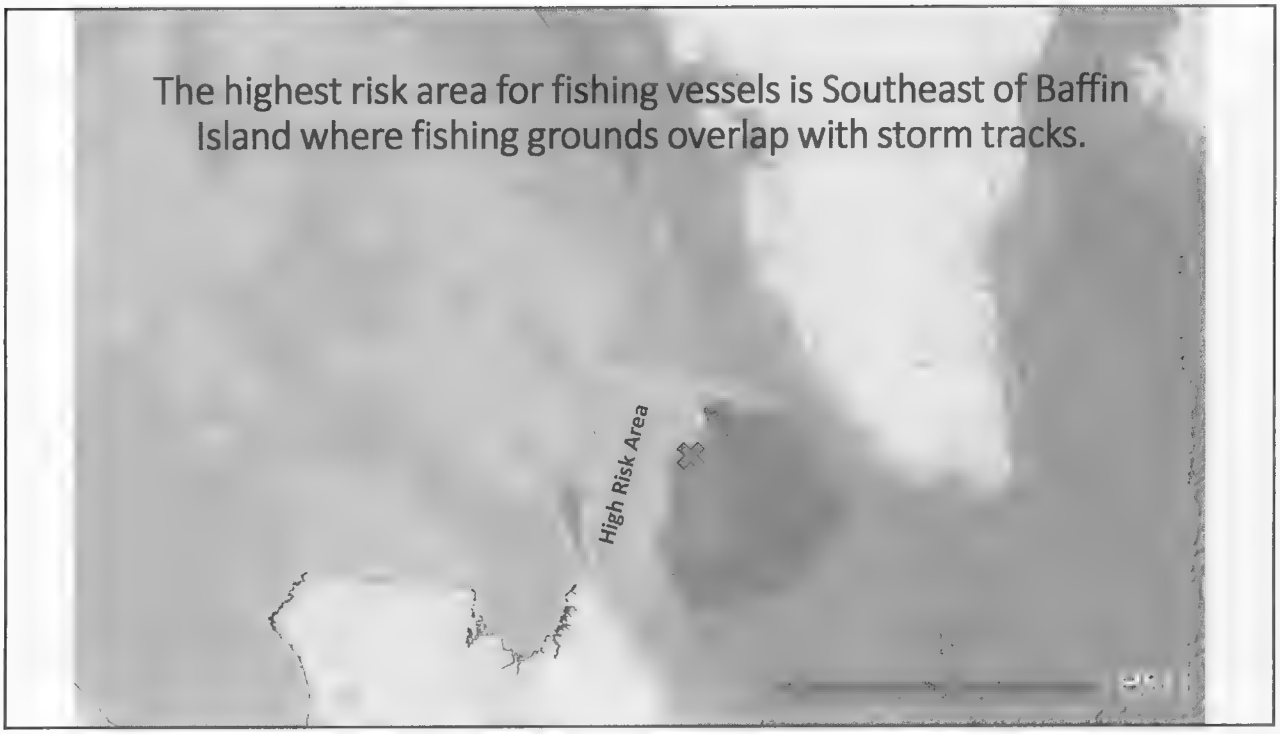
		Total	General	Tanker	Passenger	Research	Fishing	Transpo	[illegible]
[illegible]	2016	28	11	4	6	2	0	2	3
	2015	22	12	6	2	0	0	0	2
	2014	35	17	5	6	2	0	2	3
	2013	27	14	7	3	0	0	0	3
	2012	24	12	5	3	0	0	0	4

Maritime Geography

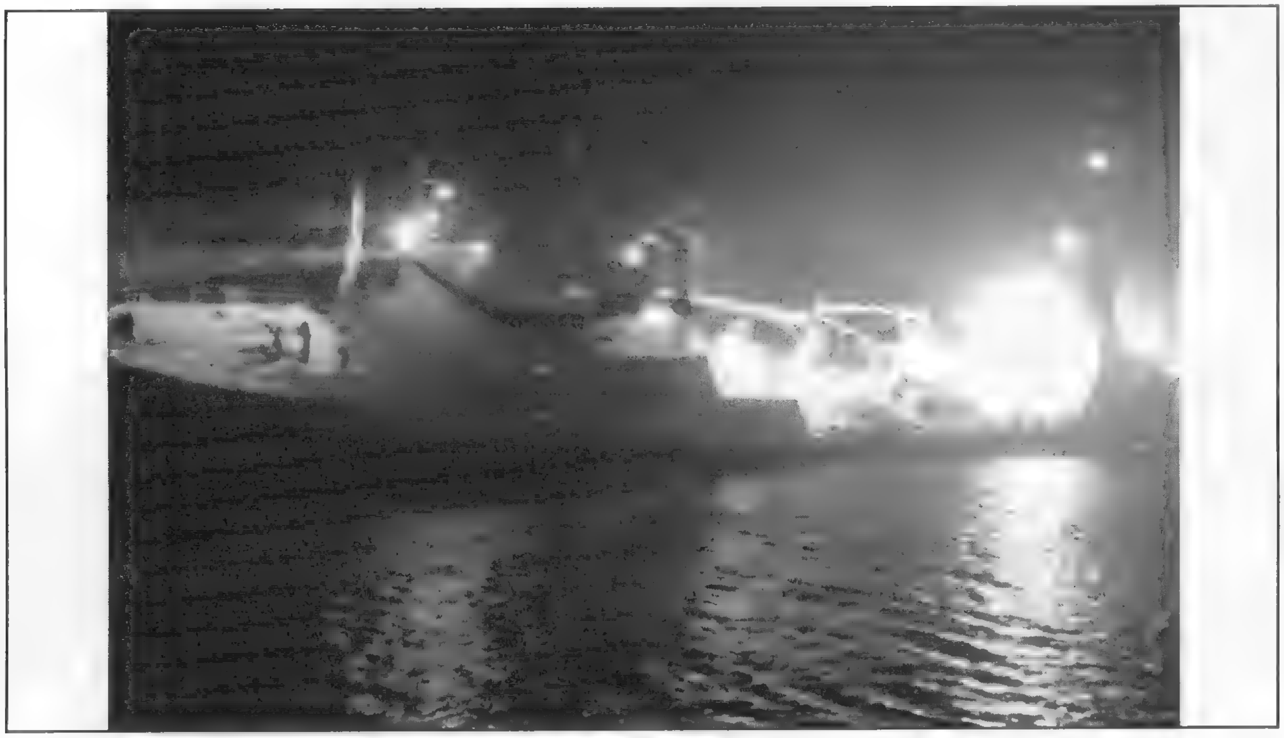
"The CHS has surveyed less that 10% of Arctic waters to modern standards"


BAFFIN ISLAND
FROBISHER
QUEBEC
DIANA BAY
TIDAL CURRENTS
AT HIGH WATER (DIANA BAY)
CURRENT SPEED (KNOTS)
1
2
3
4
5
CONSULT TEXT FOR
INTERPRETATION


Navigation
Hazards
Winds
Swell
MSC50 - 15510
Normal wave
Cross-current wave
current


The highest risk area for fishing vessels is Southeast of Baffin Island where fishing grounds overlap with storm tracks.
High Risk Area


138775
SAPUTI
QIKIQTAALUK FISHERIES
Case Study: Saputi
© Adawo
MarineTraffic.com




Costal Population Centers

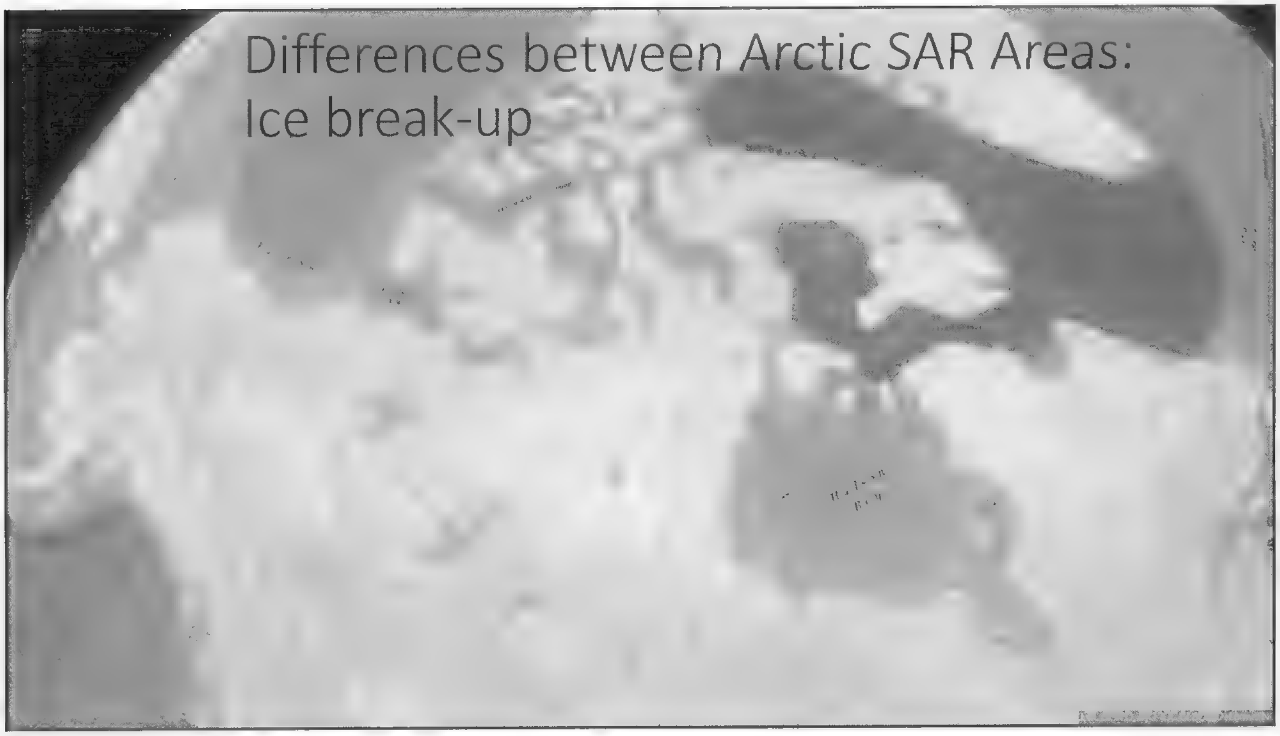
First Nations – Subsistence Fishing

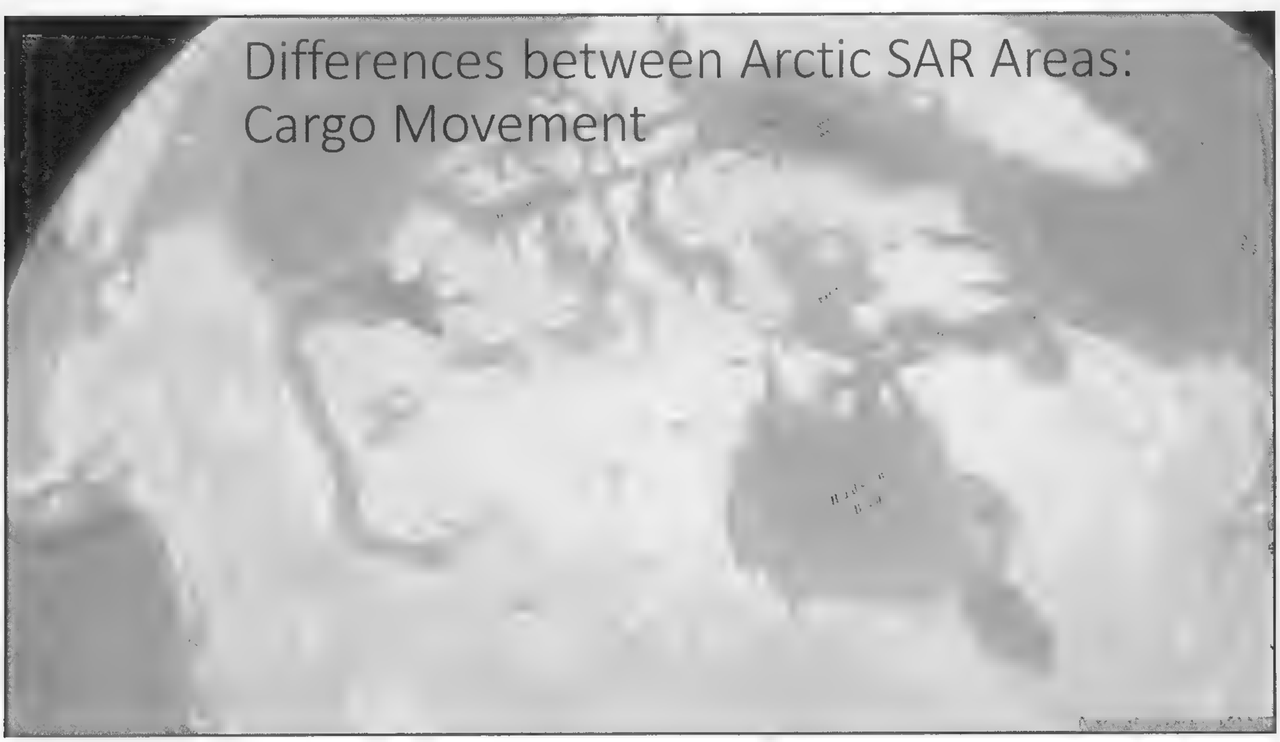
Nunavut	23030	50.11% of Inuit in Nunavut participate in harvesting activities. The remainder do not hunt, fish, gather, or trap
Nunavik	8710	49.71% of Inuit in Nunavik participate in harvesting activities. The remainder do not hunt, fish, gather, or trap

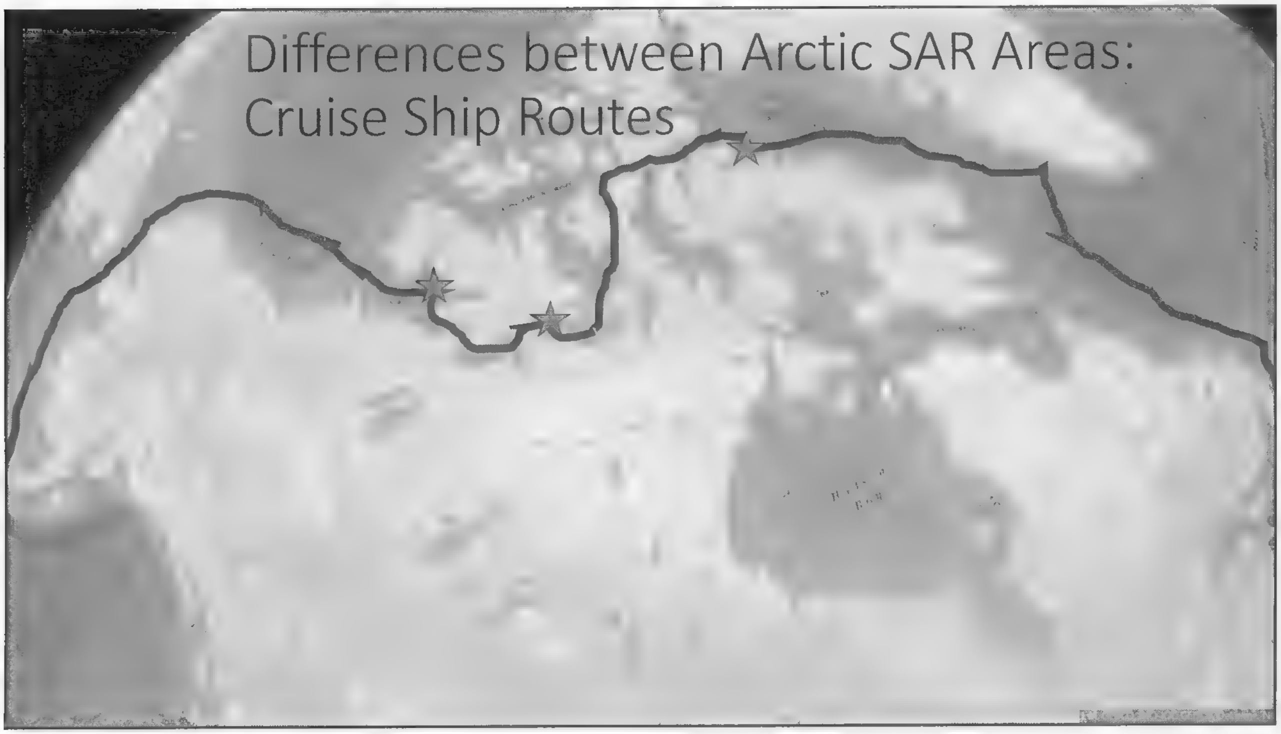
Recreational Boating

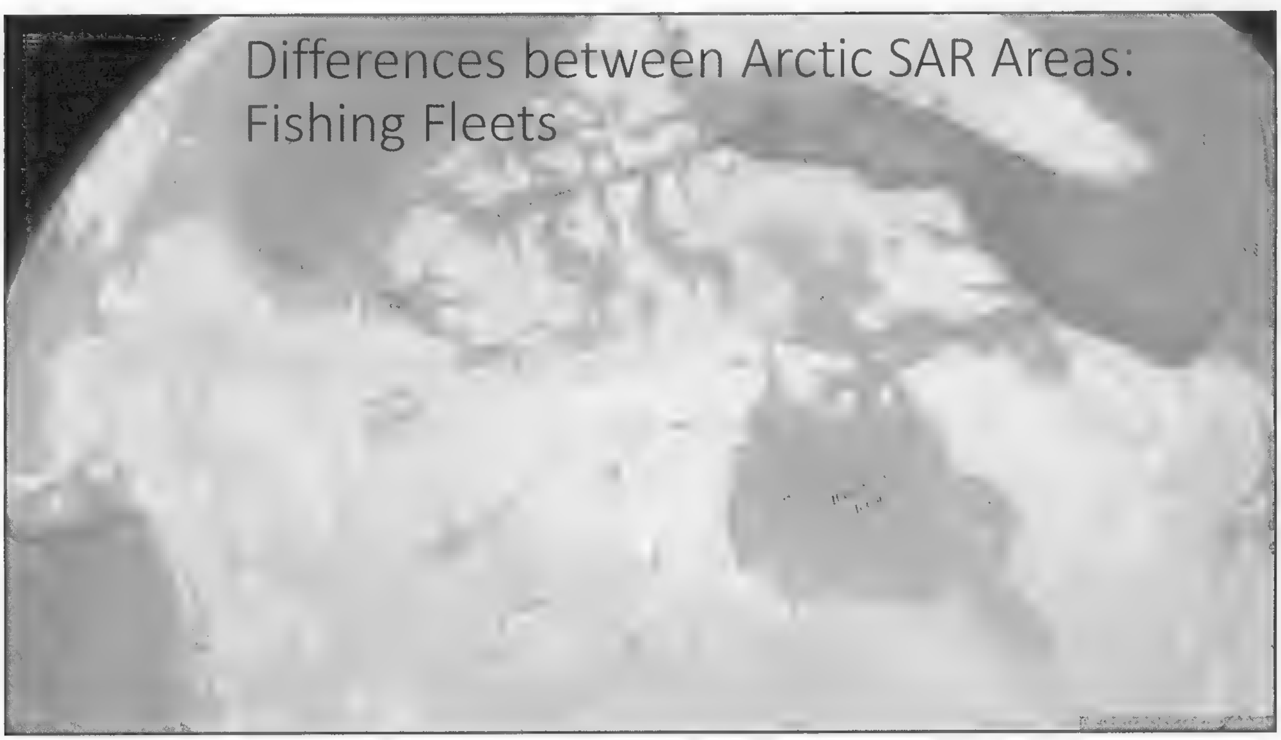
Differences between Arctic SAR Areas

- Ice break-up conditions
- Cargo movement (barge vs merchant cargo)
- Cruise ship routes
- Fishing fleets


Differences between Arctic SAR Areas:
Ice break-up


Differences between Arctic SAR Areas:
Cargo Movement


Differences between Arctic SAR Areas:
Cruise Ship Routes

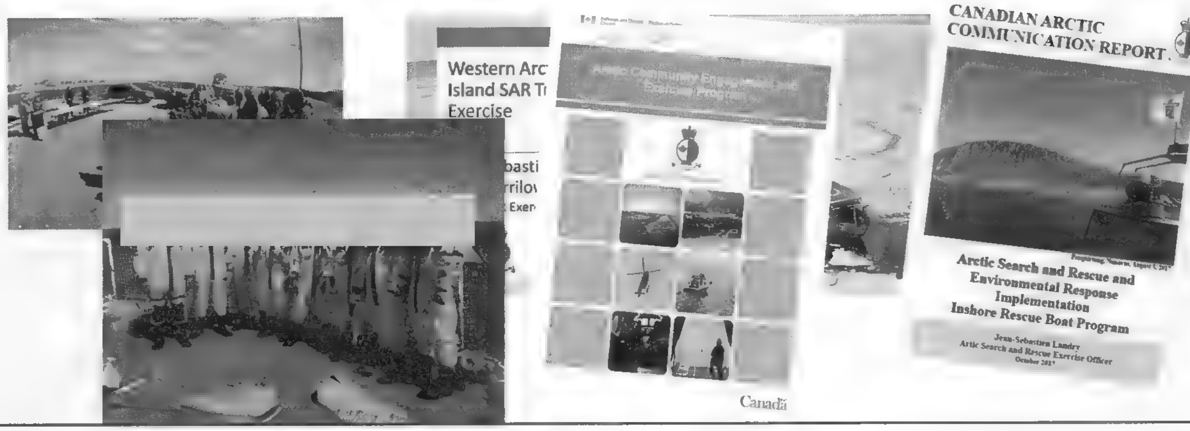

Differences between Arctic SAR Areas:
Fishing Fleets


Differences between Arctic SAR Areas:
Small Craft Transiting

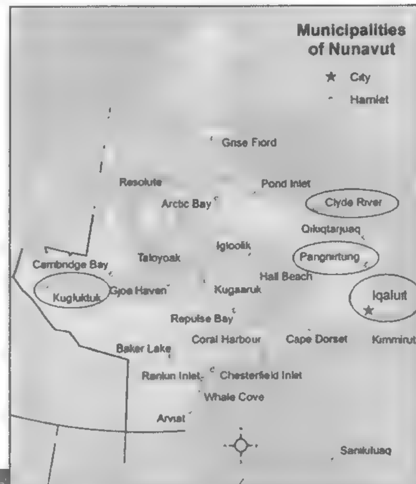

Arctic SAR Areas
Risk Profile to Date
010, 155, 259, 260

Project management

- Limited experience in SAR
- I like challenges and contribute to positive outcomes



Project management



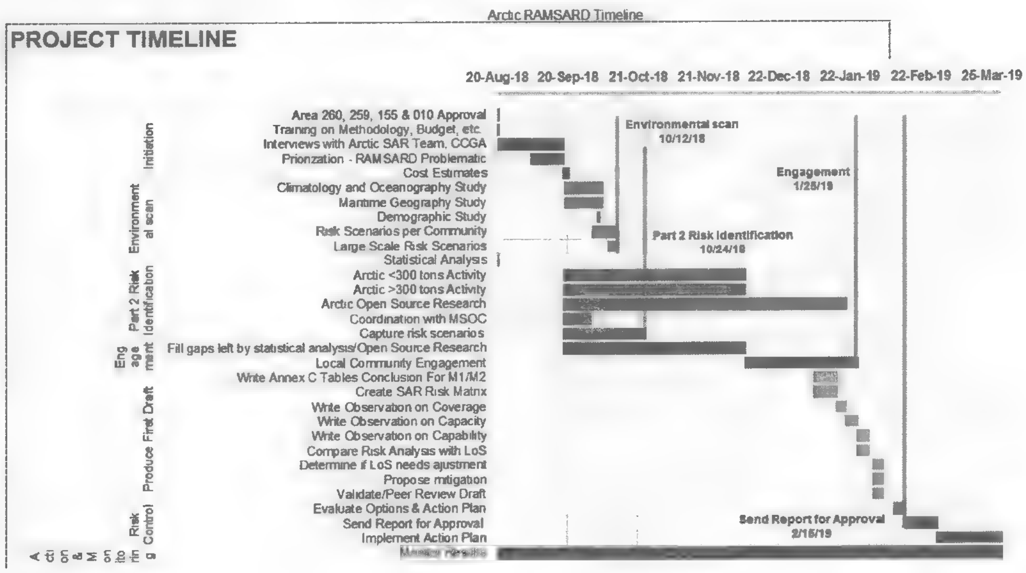
July 25th to **August 14h,** 2017

Introduction | Training and exercise | Vessel inspection | Environmental response | Communication | Conclusion

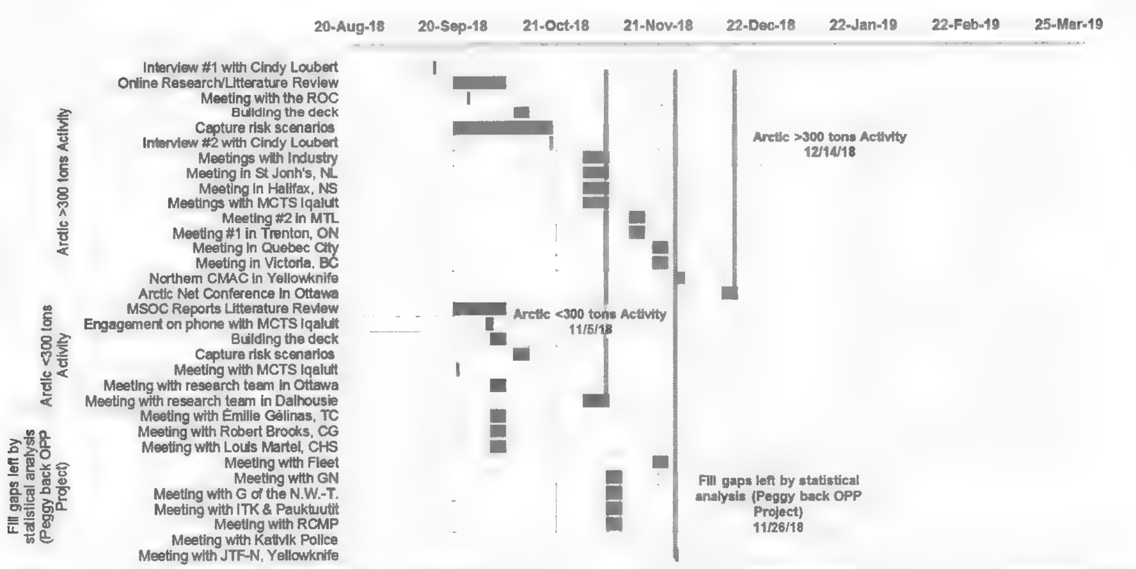
Project management

- Limited experience in SAR
- I like challenges and contribute to positive outcomes
- Background in Education, Sciences, Project Management
- Background in research. However paper not academic.
- With the research aspect of RAMSARD not completed – not ready to tie loose ends with my own limited SAR expertise
- 2nd round of engagement in February is required prior to final draft.
- Feeling much relaxed compared to October 2018

Project status in October 2018



Project status in October 2018



Voicing concerns after CCGA interviews

Communities	Engagement that is required	Engage by phone?	Rationale	Comments from Internal interviews
Inuvik (258)		Yes	CCGA established for 20 years	Darlene: (...) they're one of our best units actually.
Aklavik (258)		Yes	CCGA Arctic Director is in contact with RCMP officer who is coordinating CCGA establishment	Darlene: That community has been put on hold for a while. The Arctic Director Phil has gotten a new member that we just brought on board and he's RCMP up there. And he's actually going to start trying to rally the troops and get the unit running up again. So that's the plan. P. Garapick: Aklavik is in the middle of the Delta of the Mackenzie River, so you have a lot of transiting between Inuvik and Aklavik.
Tuktoyaktuk (258)	In person		Potential: RB Station. RCMP stepping out of maritime SAR. Have expressed concerns regarding Fathom Barge grounding and associate lack of SAR capacity	D. Ell: Tuktoyaktuk, we actually get not very much up there, believe it or not, we only had one or two bigger searches that have gone out into the Bay. Most of the stuff is down in the Mackenzie River, which falls under police jurisdiction, and they tasked the CCGA directly so we're not involved. Darlene: We got a new unit leader there right now. So she's doing actually quite well. She's in training right now in Hay River as well. I'm not overly concern, we're trying to get another vessel register with them I hope. It's taking a little longer than it probably should but again, that's
Yellowknife (258)		Yes	Well established CCGA Unit. ER engagement Oct. 22-26	ACEEP TEAM: Summer 2018 SARex went as expected for an well establish CCGA Unit.
Sachs Harbour (258)		Yes	Low maritime activity area. Confirm P. Garapick statement with community, scientific literature and economic trends	P. Garapick: Ok so there's nothing in Sachs Harbour. It's a very small, low activity area. No one goes or comes from the place. It's isolated, it's just local boating. It's minimum, and it's very difficult to generate interest so it was low on our list. (Um), we don't have any stats but I'm sure someone could go out there and get into trouble but, I think (yeah), we don't know a lot about Sachs because it's low on the list. We learn
Ulukhaktok (258)	In person		Engagement occurring Sept. 21, 2018. Delivery of a SAR vessel.	Darlene: unit needs more members.
Paulatuk (258)	In person		Possible increased tourism (Protected Area). No existing community contact.	D. Ell: They do a lot of what we're running all around there, but maybe one or two cases up there in thirty years so... Darlene: Paulatuk I've been doing follow up with them since I got back. The SAO, I've been talking to him..., it doesn't look hopeful, based on my conversations with him it was actually a bit abrupt the last time.
Kugaaruk (260)	In person		Was not included in 2015-2017 RAMSARD engagement.	Darlene: I've been talking to someone there in August, this month I was talking to the SAO and then there's Bobby, which was the acting SAO, gave me the SAR coordinator, they are working on the SAR society paper right now.
Taloyoak (260)	In person		No continuation of communication since last discussions about a CCGA Unit in February 2017	D. Ell: It seems to have a lot of traffic going along the corridor between Gjoa Haven and Taloyoak and vice versa. Darlene: With them we got a number of applications but they're from a long time back so I've been doing follow up for a long time and I've stopped following up again. It's hard to get them reply to me. To be honest, We've done email, I've left numerous voicemail, can't get a reply
Gjoa Haven (260)	In person		CCGA Unit not yet well established, and issues contacting the Unit itself. Seems to be a lot of traffic. They will receive a new boat.	M. Gagnon: What is lacking is follow-up in regards to getting back to the communities and ensuring the training package delivered in Yellowknife in 2016 are working and that the on-water component of the training program is actually being utilized within the communities. D. Ell: It seems to have a lot of traffic going along the corridor between Gjoa Haven and Taloyoak and vice versa. ACEEP TEAM: It will be very important to monitor this unit in the near future, with them receiving their new boat and building for their boat as well as the gear associated with it, to ensure it is put to proper use
Cambridge Bay (260)		Yes	Well established CCGA Unit.	2018 ACEEP TEAM: The unit is comprised of 12 members but they are planning to expand as they will be receiving a new boat next summer. They hope by growing the unit, it will allow them to be more readily available for set training days. It was also mentioned that communication between community members and JRCC is now improved.
Kugluktuk (260)		Yes	CCGA Unit not yet well established, feeling discouraged because lack of training. However, CCGA is looking into having more conference calls with the U/L.	2018 ACEEP TEAM: The unit is willing to participate in more training and is hoping that there will be more presence of Coast Guard personnel. Darlene: There was a few challenges there where they were feeling discouraged, but I actually spoke with the unit leader yesterday (...). It's positive, he's planning to bring in a couple more members. We're trying to fill out the application for the new boat.
Arviat (155)	In person		Not interested in doing a SAR society.	2018 ACEEP TEAM: In getting to know the potential candidates, they have expressed a great concern for the creation of a SAR society because their "concerned that we [the government] were trying to change them rather than listen to what works best for their community". Darlene: They want everything to follow through the hamlet which can't be. P. Garapick: If we got there face to face, and have the money to go visit, we would get somewhere.
Whale Cove (155)	In person		Interested of going forward with a SAR society, but unclear motivations. Need to capture risk scenarios. To evaluate if identified risks are acceptable or not for the community.	Darlene: I was talking to the SAO only a couple of weeks ago and they're very excited.
Rankin Inlet (155)	In person		Rankin Inlet URI-N: what is the feedback from the community? CCGA is extremely motivated again, seems to be correlated with the application for the new vessel. Need to capture risk scenarios. To evaluate if identified risks are acceptable or not for the community. Oct/Nov. possible ER presence	Darlene: They were not as involved, but since that we gotten on board with the new boat, they're really excited about everything.
Chesterfield Inlet (155)	In person		Concerns over SAR society paperwork. To capture risk scenarios. To evaluate if identified risks are acceptable or not for the community. Oct/Nov. Possible ER presence	ACEEP TEAM: We have noticed that many already partake in SAR activities when it is necessary to rescue community members. There is a great interest in a CCGA unit and there is clearly a need because it is high traffic area with pleasure craft trying to make their way to Rankin Inlet, Naujaat and others for hunting.
Naujaat (155)	In person		Working on SAR documents. Great communications with the SAO. Engagement should be possible over the phone. However, risk scenarios and risk control measures should be discuss in person.	ACEEP TEAM: They will put a memorandum of understanding with Park's Canada so they will be able to use their vessel should a SAR tasking arise. (...) A concern he (the SAO) brought to our attention was that a large majority of the time they are surrounded by ice. When the ice starts to break apart. That is when a lot of their rescues take place.
Coral Harbour (155)	In person		High maritime SAR culture, but no structure including JRCC. SAO recall 2016 RAMSARD Coast Guard visit where CCGA process was explained, he did not specified the outcome of the meeting.	ACEEP TEAM: They have SAR members established, but have yet to establish a SAR society. (...). Right now, their searches are typically activated from those community members with a satellite phone, a SPOT device, or by members coming up missing when they are expected at a certain time. At this point, locals use their personal vessels to go out for rescues. They describe Coral Harbour as a "hub" for boaters making
Baker Lake (155)		Yes	Oct/Nov possible ER presence	

Voicing concerns after CCGA interviews

Communities	Engagement that is required	Engage by phone?	Rationale	Comments from Internal interviews
Churchill (155)		Yes	CCGA well establish. Oct 9-16 ER presence	ACEEP TEAM: Since becoming a newly established unit in 2017, they've had a couple rescues for disabled vessels who ran out of fuel. In addition, their boats are in exceptional working conditions as they are kept clean and functioning for the daily hours.
[illegible] (010)	In person		Potential: RB Station? CCGA file seems to be stagnant	Darlene: They want to come on board. Trevor Taylor is waiting on a boat that he had ordered. I got to do follow-up with him. And he's open to be able to get some stuff up and running there.
Pangnirtung (010)	In person		CCGA file seems to be stagnant	ACEEP TEAM: The Pangnirtung CCGA unit looks to be heading in the right direction. They have a vessel that is seaworthy and is in very good condition for SAR purposes. There is a good base of 5 members who are all motivated to improve the unit in the future. With a little more guidance the unit will be able to become very well established and grow within the next few years.
Qikiqtarjuaq (010)	In person		Hard to contact. No response from the SAO.	
Clyde River (260)		Yes	Unit has very recently been approved to become a SAR society. Will become part of the Guardian program	Darlene: They have their SAR society done, they need new equipment for the boat. Most, if not all of the joining members are already a part of land SAR in the area and are very knowledgeable when it comes to SAR situations. With the proper marine training, Clyde River will be completely ready to respond as a Canadian Coast Guard Auxiliary unit. ACEEP TEAM: There were a few issues with the boat
Pond Inlet (260)	In person		Very little info on this community available. Will become part of the Guardian program	Darlene: waiting to follow up on paperwork
Arctic Bay (260)	In person		Very little info on this community available. Will become part of the Guardian program	Darlene: They're working on the SAR paperwork
Cape Dorset (010)	In person		Community not replying to CCGA	Darlene: So they're kinda added to the list of finding an alternative way of contacting them.
Kimmirut (010)	In person		Very little info on this community available. Community not replying to CCGA	Darlene: The only response I got from them last summer is them saying they were checking to find out if they had a vessels that they could use for so on.
Sanikiluaq (155)	In person		Very little info on this community available	Mark: The SAO is interested of becoming one auxiliary members, and to apply to the boat program. They seem to be a pretty active community in regards to community SAR and they're also on an island so.
Igloolik (155)	In person		Very little info on this community available	Darlene: They seem rather confused because when we left they're initially gonna do the SAR society work and all of that, but we never received anything from them.
Hall Beach (155)	In person		Very little info on this community available	Darlene: They seem rather confused because when we left they're initially gonna do the SAR society work and all of that, but we never received anything from them. I was dealing with Jim, and he thinks we're pretty much wasting our time with them. But whether this is his opinion, or whether it's fact, it's hard to read between the line.
Grise Fiord (260)	In person		Very little info on this community available. Community not replying to CCGA. Will become part of the Guardian program.	Darlene: I've sent them a boat application, I have emailed the SAO and then a couple contacts there. The mayor. And I have really got no answer, no voicemail.
Resolute (260)		Yes	Short boating season. Other SAR resources seems to be sufficient. Will become part of the Guardian program. Sept 17-21 Engagement by ER	Mark: Resolute Bay is one of the community they're putting the guardian this year. They got about an hour and an half boating season, and it's very heavy Canadian military equipped there.
Inukjuak (155)	In person			CCGA-Q: 5 members
Akulivik (155)	In person			CCGA-Q: 1 member
Puvirnituq (155)	In person			CCGA-Q: 0 member
Ivujivik (155)	In person			ACEEP TEAM: We learned that currently, they have no set structure for dispatch rather the hunters and trappers take care of the paperwork and organizing team members to go out. The town manager expressed to me that it is one of the goals for them to better understand a structure of how it should be done.
Umiujaq (155)	In person			CCGA-Q: 5 members
Kuujjuarapik (155)	In person			CCGA-Q: 4 members
Kuujjuaq (010)	In person			CCGA-Q: 1 members, vessel authorized
Kangiqsualujjuaq (010)	In person			CCGA-Q: 4 members
Tasiujaq (010)	In person			CCGA-Q: 0 member
Aupaluk (010)	In person			CCGA-Q: 4 members
Kangirsuk (155)	In person			CCGA-Q: 1 member
Quaqtaq (010)	In person			CCGA-Q: 1 member
Kangiqsujuaq (155)	In person			CCGA-Q: 4 members
Salluit (155)	In person			CCGA-Q: 6 members, vessel authorized
Rupert River (155)	In person			
Chisasibi (155)	In person			CCGA-Q: L'approche de la Garde côtière est: Louis, serais-tu prêt à ouvrir une unité à Chisasibi? On connaît l'environnement, on sait que la police ne veut pas s'impliquer. (...) donc le gouvernement se lance dans ça et veut nous lancer ça entre les mains. Au lieu d'avoir dit : on va évaluer où sont les endroits où on a des faiblesses SAR. Après ça, comment va-t-on trouver les solutions pour arranger ces choses-là?
Wemindji (155)	In person			
Vieux-Comptoir (155)	In person			
Eastmain (155)	In person			

Where RAMSARD fits in the SAR Program?

What is expected from the Region for 2018/2019?

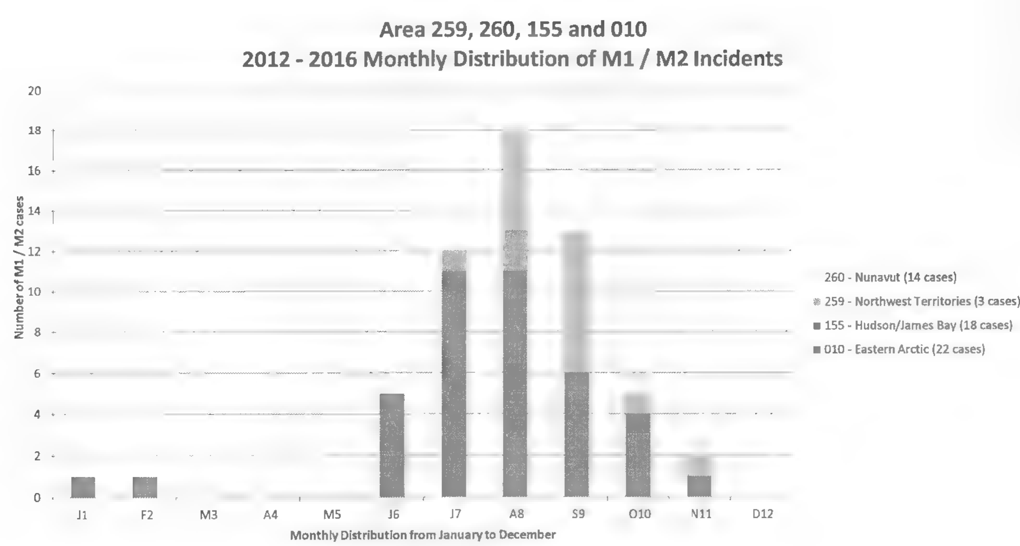
s.21(1)(b)

End of October

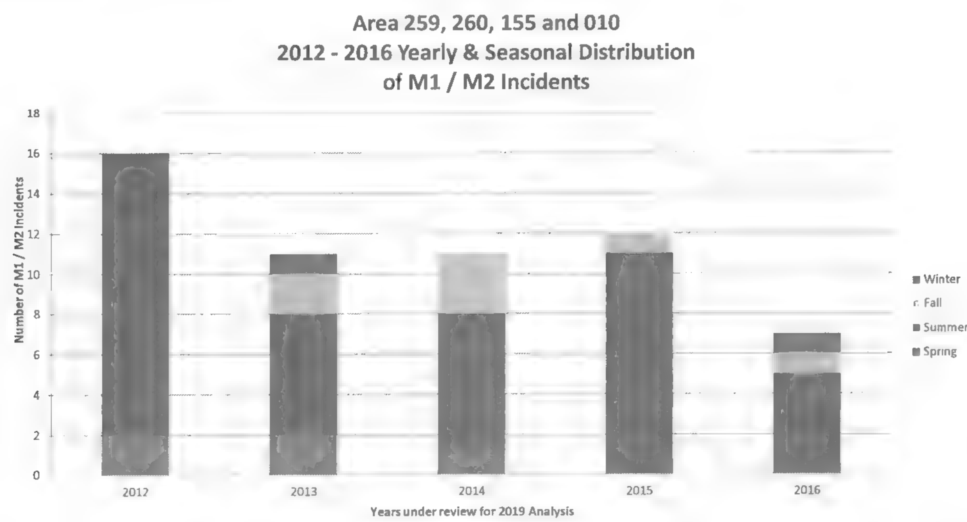
- Pressure was relieved – had support from my Region to accept limitations in completing methodology
- Past Arctic SAR Experience has to be reflected in the report
- However, guidance unclear in Manual on how Report influence SAR Ops
- What's next?:
  - RAMSARD might not have a role in leading SAR implementation, engagement rationale is unclear in Manual when implementation processes are already moving forward.
- Had a 95 K budget [redacted]
- Ready to go!

Let's dive in!

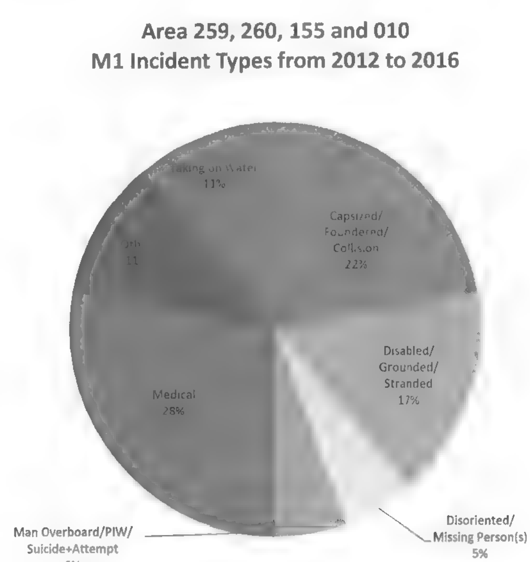
Monthly Distribution



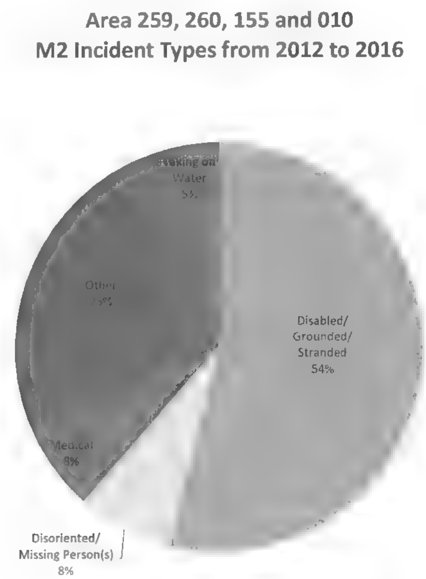
Yearly and Seasonal Distribution



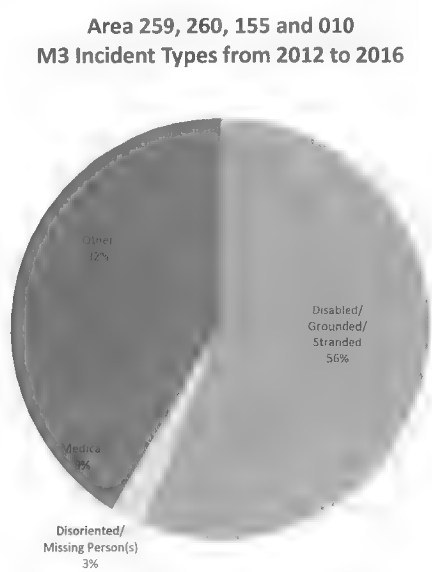
Incident Type Proportion



Incident Type Proportion



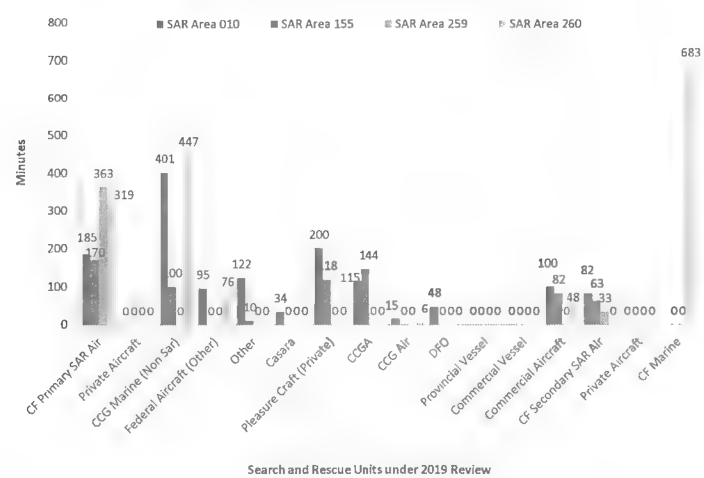
Incident Type Proportion



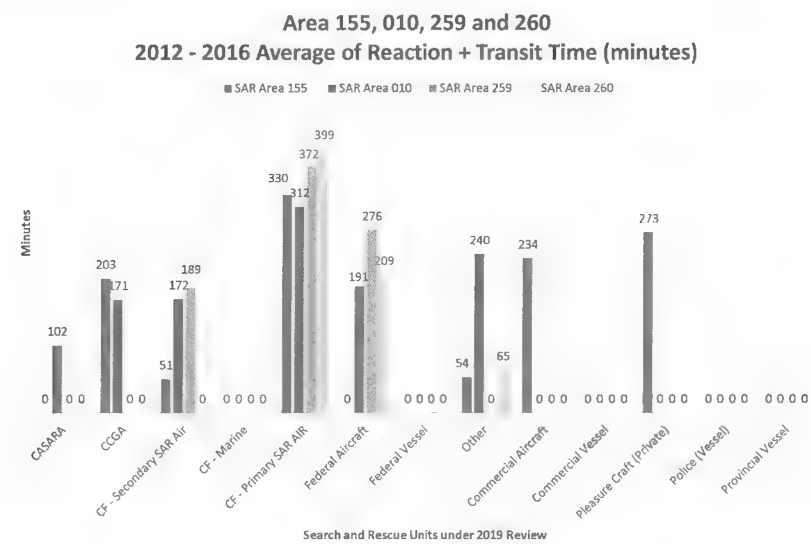
Which SRUs are available to respond to these calls in the Arctic?

Who was On Scene?

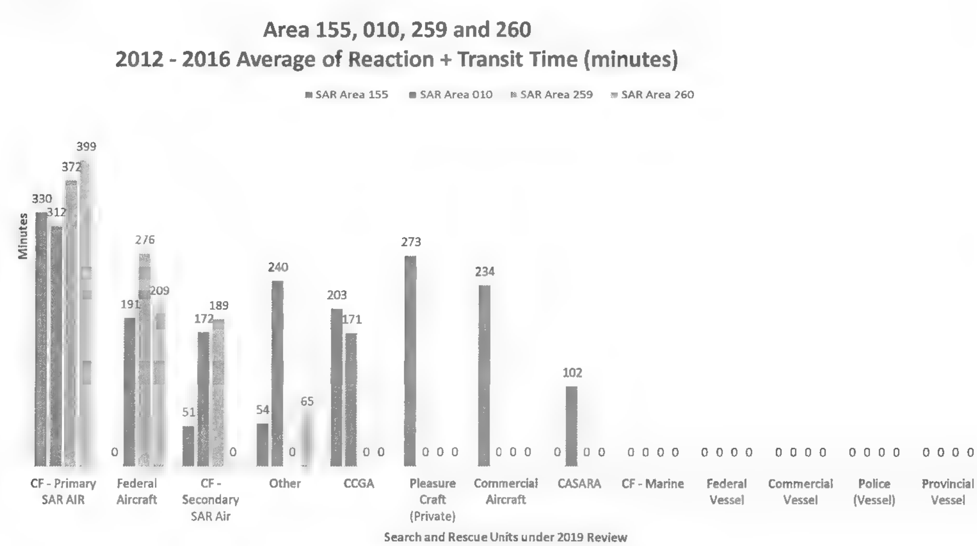
2012 - 2016 Average SRU Time for Departed to On Scene (minutes)



Who was On Scene?



Who was On Scene the most?



How valid is this snapshot of available SRUs?

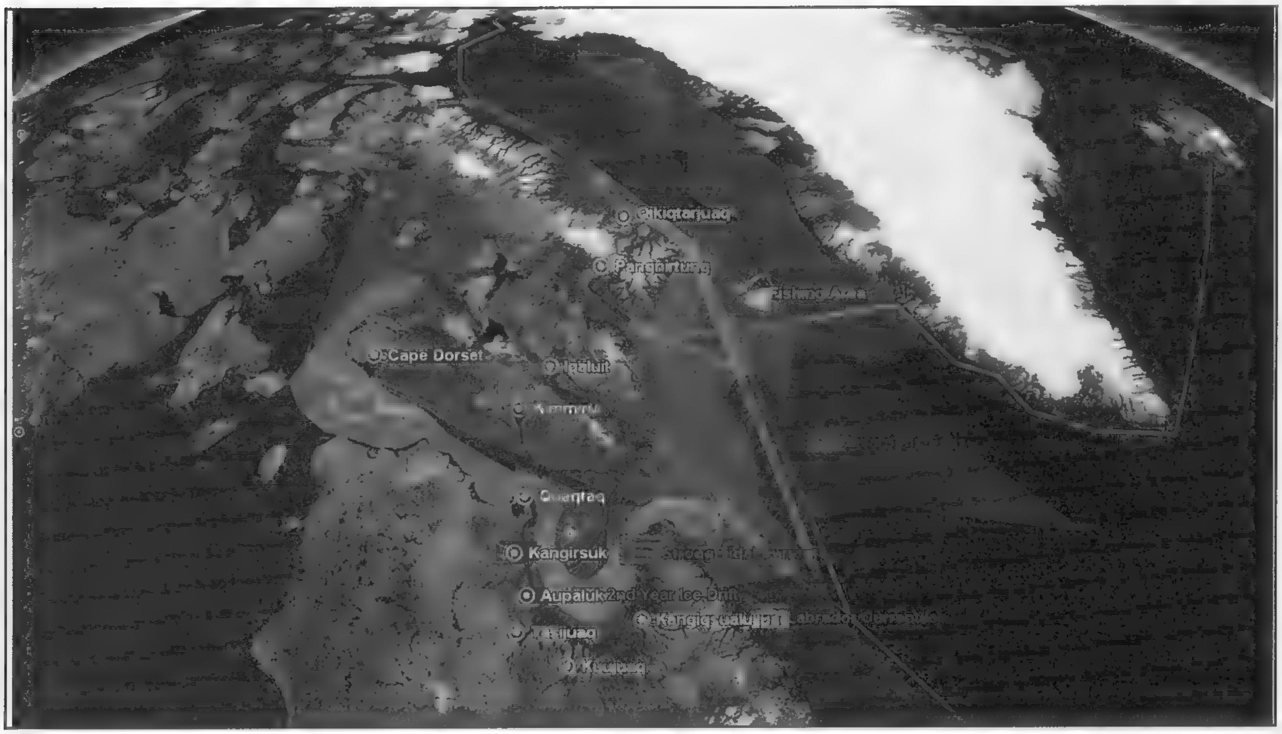
	# Years Response Time was Recorded per SRU			
SRU	SRA 010	SRA 155	SRA 259	SRA 260
CF Primary SAR Air	5	3	1	3
Other resources	4	1	0	0
CCG Marine (Non SAR)	3	1	0	3
Federal Aircraft	3	0	0	1
CCG Air	2	0	0	3
Pleasure Craft (Private)	1 (200)	2	0	0
CCGA	2	1	0	0
Commercial Aircraft	1 (100)	1	0	1
CF Secondary SAR Air	1 (82)	2	1	0
DFO	1 (48)	0	0	0
Casara	1 (34)	0	0	0
Commercial Vessel	0	0	0	0
Provincial Vessel	0	0	0	0
Private Aircraft	0	0	0	0

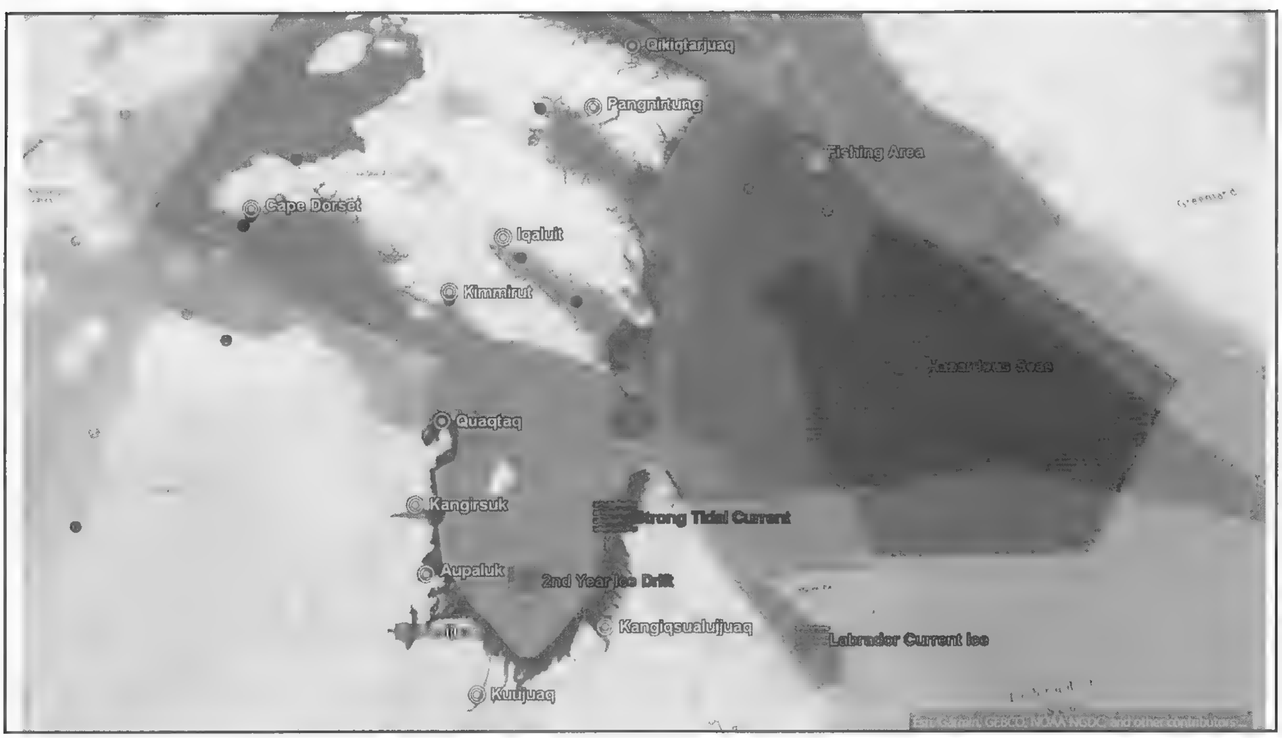
Useful to understand the availability of SRUs.

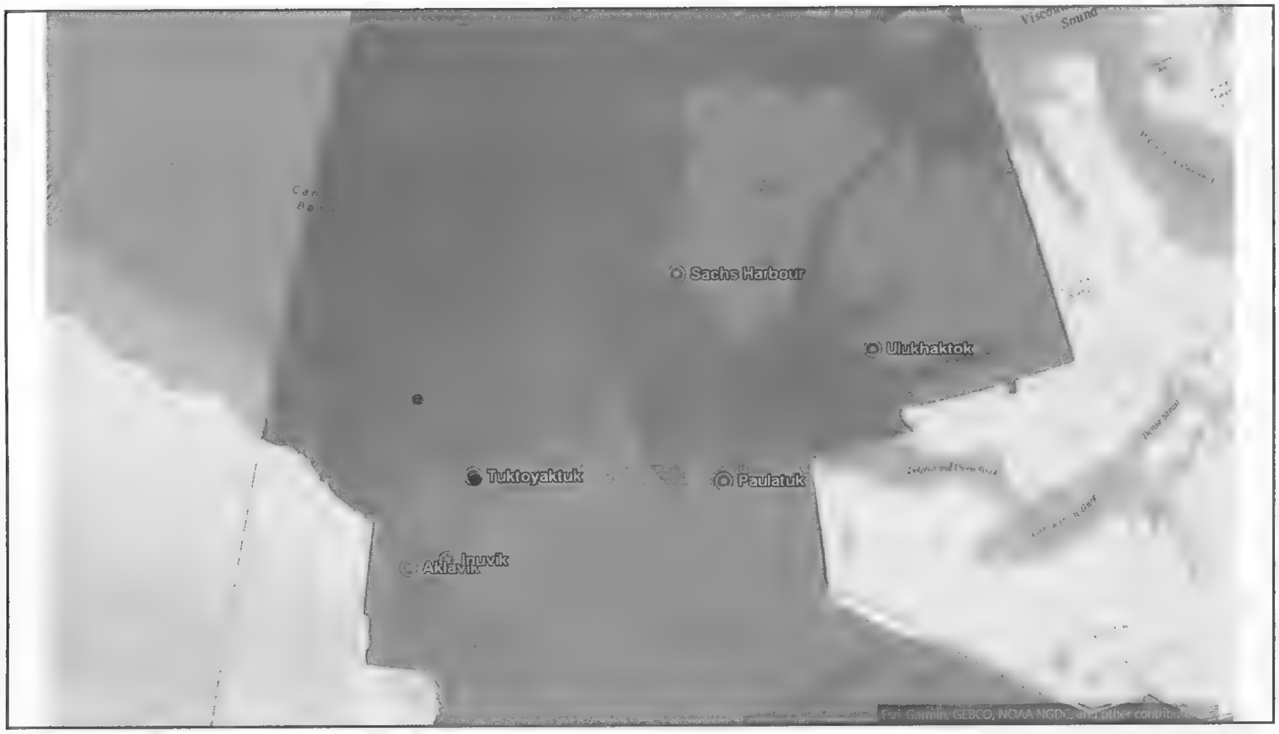
Not for assessing the SAR Response Performance

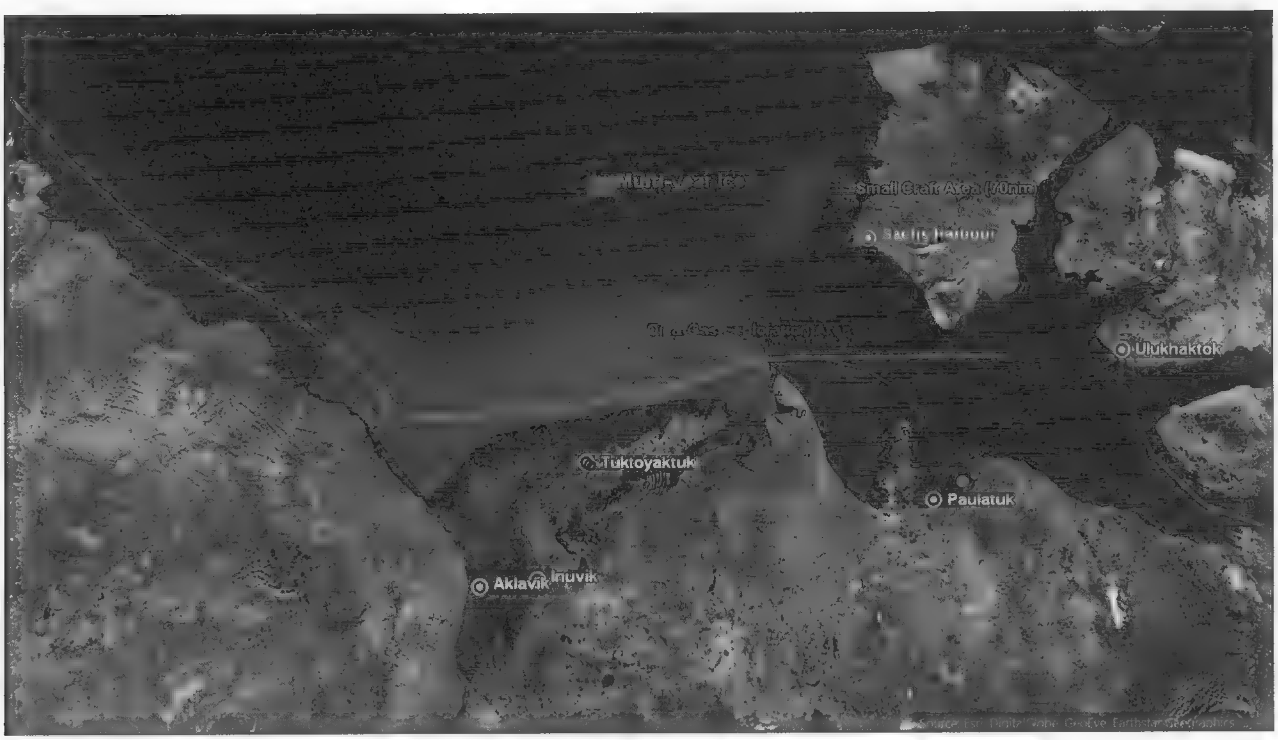
Valid Incident Types

Where incidents are happening?


Qikiqtarjuaq
Cape Dorset
Iqaluit
Quaqtaq
Kangirsuk
Aupaluk
2nd Year Ice Drift


Qikiqtarjuaq
Pangnirtung
Fishing Area
Cape Dorset
Iqaluit
Kimmirut
Quaqtaq
Kangirsuk
Strong Tidal Current
Aupaluk
2nd Year Ice Drift
Kangiqsualujjuaq
Labrador Current Ice
Kuujjuaq

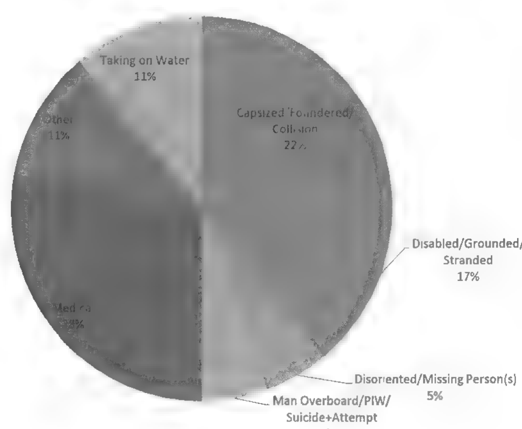

Sachs Harbour
Ulukhaktok
Tuktoyaktuk
Paulatuk
Inuvik
Aklavik


Sachs Harbour
Ulukhaktok
Tuktoyaktuk
Paulatuk
Aklavik
Inuvik

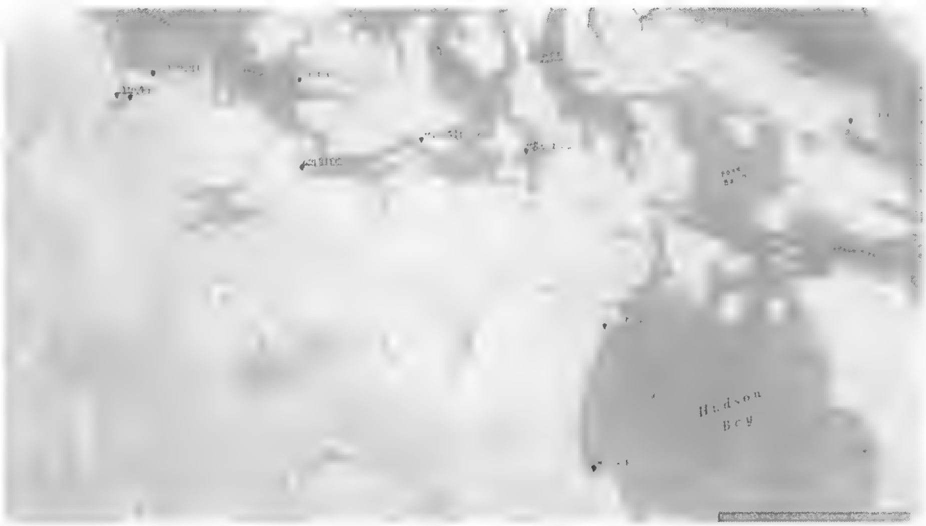
M1, M1P & M2 SAR Incidents Locations from 2012 to 2016

Incident Type Proportion

Area 259, 260, 155 and 010
M1, M2 and M3 Incident Types
from 2012 to 2016



CCGA and IRB AOR



2018 IRB-N Cases

- Case 1739 M-3 report of a disabled boat but person recovered by another vessel before IRB departed
- Case 1857 M-4 report of an overdue vessel, IRB commenced search, during search overdue boat made it back to community never having been in difficulty
- Case 2009 M-3 Report of a disabled vessel, IRB tasked, located and towed vessel to safety

AOR we're missing

- Rangers
- Fire Dept.
- Parks Canada Guardian Program

- Self-reliance…

- Next step : interview with CCGA Liaison Officer.

Potential engagement coming up

- Jan 30th to Feb 6th (**Eastern Arctic** – Iqaluit, Pang, Qik, Clyde River, Pond, Arctic, Kimmirut, Arviat, Igloolik, Hall Beach))
- Feb 13th to 22nd (**Central Arctic** – Iqaluit, Chester, Coral, Whale Cove, Naujaat, Cape Dorset, Kuugaruk)
- Feb 25th to March 2nd (**Northern Quebec** – Kuujjuaq, Kangirsuk, Salluit, Puvirnituq, Umiujaq)
- March 19th to 22nd (**Western Arctic** – Yellowknife, Inuvik, Aklavik, Tuk, Ulu, Paulatuk, Kug, Hay River)
- March 19th to 22nd (**Cree Nations in James Bay** – Eastmain, Chiasasibi, Whapmagoostul, Wemindji, Waskaganish)

Priority for JRCC

1. Increase number (and training) of CCGA in the Arctic
2. Enhance communication capabilities
3. Contractible resources (air, marine and support) within a community
4. Reporting requirements for vessels under 300 GT to NORDREG for situational awareness
5. Given limited icebreakers, SAR Patrol Zones combined with community resupply and icebreaking. Informing industry well beforehand.
6. Cruise ships to travel in tandem so that they can act as a response vessel in case of emergency
7. Mass Rescue (already being taken care by NHQ)

CCG Performance Standard for Arctic

CCG Performance Standard for Arctic (010,155,259,260):						
Row Labels	Sum of SUM POB	Sum of SUM Assisted	Sum of SUM Saved	Sum of SUM Lost	Sum of SUM Missing	Result
2012	46	4	40	1	1	97.83
2013	32	0	32	0	0	100.00
2014	33	0	31	0	2	100.00
2015	52	11	41	0	0	100.00
2016	47	0	46	0	1	100.00
Grand Total	210	15	190	1	4	99.52

"Real" CCG Performance Standard for Arctic

2012 – 2016 CCG Performance Standard for Arctic (010,155,259,260):				
Row Labels	Sum of SUM Saved	Sum of SUM Lost	Sum of SUM Missing	Result
2012	40	1	1	95.24
2013	32	0	0	100.00
2014	31	0	2	93.94
2015	41	0	0	100.00
2016	46	0	1	97.87
Grand Total	190	1	4	97.44

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NEWS 5 DECEMBER, 2018 – 9:30 AM EST

Arctic SAR efforts need better training, more Inuktut, Senate report says

Search and rescues expected to rise

Senator Mark Gold during a visit with Canadian Coast Guard auxiliary members in Kuujjuaq. The senate committee on Fisheries and Oceans released a report last week that says community support is crucial to search and rescue response in the Arctic. (SENATE STANDING COMMITTEE ON FISHERIES AND OCEANS)

By BETH BROWN

Maritime search and rescue efforts in the Canadian Arctic need upgades to radio communication systems, better training for volunteers and more Inuktut-speaking Coast Guard staff, a Senate committee said in a 71-page report.

In 2014, the RAMSARD methodology was presented to the SAR regional superintendents with the expectations that it would be implemented in the following months. The Superintendents quickly determined that the strategy could not be adopted without additional human resources and funding, and that the methodology required reassessment in order to make it more practical than theoretical.

The RAMASRD project was indefinitely postponed; however, in 2016 the World Class Projects of the evaluation of Arctic Search and Rescue and Expanding CCG Auxiliary in the Arctic began. Over a period of 2 years, a team led by Peter Garapick travelled across the Arctic and engaged community leaders, government employees, local hunters and fishers, first responders and various agencies to determine the steps that could be taken to increase SAR capacity in the north. The focus was solely on the expansion of CCG Auxiliary units.

While the RAMSARD project remained under review, from 2016 – 2017 the Arctic SAR Team applied the methodology that was presented in 2014 and collected data from every community and every meeting. In all ways, the Arctic RAMSARD Study that was written in January 2018 reflects RASMARD as it was known at the time. The appendices present the extent of the factors considered and data collected.

Since mid-January 2018, RAMSARD has been resurrected with a robust team and budget and has been reinterpreted and improved. Although it has not yet produced results, the expectations is that the refined and improved RAMSARD will reap effective recommendations to ensure that gaps and redundancies in the national SAR system will be addressed, appropriately.

Only in hindsight might the research that was carried out from the beginning of 2016 to the end of 2017 and the resultant paper be considered less than the current RAMSARD standard. There was no standard other than the 2016 methodology. Today's revised RAMSARD should indeed reap applicable recommendations, better than the methodology presented in 2016, but the wealth of information and insight presented in the Arctic RAMSARD Study is invaluable. It has resulted in the establishment of 5 new CGA units in 2017, as many as 10 more expected in 2018, the awarding of funds for 4 communities to purchase dedicated SAR vessels, and will indubitably be a core part of the new RAMSARD analysis in the Arctic.

Clearly, the report could not meet new standards that were established after the research was carried and after the paper was written. The paper took the then current RAMSARD standards and followed the methodology established in 2014 and refined it to ensure that results were applicable to the situation in today's Canadian Arctic. The paper should not and cannot be assigned a lesser value because it is perceived to not

meet a format that is yet to be written. The Arctic RAMSARD Study is a credible report and I stand by it 100%.

Within opening remarks of the Arctic RAMSARD Study it states that the report did not consider the full suite SAR resources. In addition to being based on the 2016 RAMSARD standard, this fact also does not make it an inferior report.

"The study also solely focused on whether auxiliary units could be established and did not examine the establishment of Coast Guard Lifeboats or Inshore Rescue Boat Stations."

"As the objective was to establish volunteer SAR units – not to establish full-time Coast Guard resources – it was imperative to find volunteers and obtain the support of the broader community."

fmiosmcs